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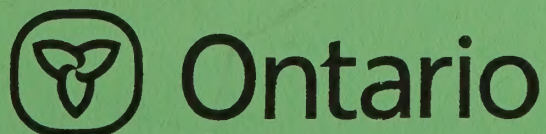
1995 AIR QUALITY DATA SUMMARY
REGIONAL MUNICIPALITY OF
HAMILTON-WENTWORTH

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1995 AIR QUALITY DATA SUMMARY
REGIONAL MUNICIPALITY OF
HAMILTON-WENTWORTH

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1995 AIR QUALITY DATA SUMMARY

REGIONAL MUNICIPALITY OF

HAMILTON-WENTWORTH

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Air Quality Assessment
West Central Region

Ontario Ministry of Environment and Energy

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1. SUMMARY

Airborne particulates (dust) including black fallout, odours, semi-volatile organics and ozone have been Hamilton's main air pollution problems.

Major improvements in air quality took place in the 1970s and steady improvements have occurred since that time.

However, in the last few years, particulates and odours have deteriorated again. Suspended particulates increased by 28% since 1993 and sulphur odours have increased by 20% since 1992.

Due to ongoing concern about the impacts of air pollution and recent data showing health effects at lower levels than previously thought, the Hamilton Air Quality Initiative has been implemented. This initiative brings together all levels of government and community stakeholders including McMaster University to assess the impacts of air pollution, identify sources, including vehicles and industry, and make practical recommendations for improvement. A report is expected in 1997.

Other trends are: dustfall (large settleable particles) was similar to 1994, but has decreased by 30% since 1986. Soiling index decreased by 14% since 1993. Inhalable particulates have been steady over four years.

Dustfall remained well above objectives in the industrial zone, and some residential parts of the City. Complaints about black fallout are continuing. In response to this, a video camera system aimed at the industrial zone has been installed, to determine which specific industries are responsible for fallout incidents and to view ongoing emissions. Special measurements have been made to identify pollution sources, and as a result, a major abatement program is starting at a local industry.

Odours due to reduced sulphur compounds have reduced by 50% since 1982, but they have been increasing again since 1992 by 20% from the 1982 baseline. That is, a 70% improvement had

been achieved, but has regressed by 20%.

The Air Pollution Index reached the advisory level of 32 three times at the downtown site and once simultaneously at the west end station. The Air Quality Index showed that ozone was the pollutant which reached the moderate range of the Index most frequently of the six measured pollutants.

Ground level ozone continued to exceed criteria throughout Southern Ontario,. It is heavily influenced by long range transport from the US and is produced photochemically to excess during the summer. Although the summer of 1995 was similar weather-wise to 1988 (hot and sunny) when a large peak of ozone exceedances occurred, that peak did not reoccur to the same degree in 1995 and may indicate the initial success of some long term control programs.

The network of fluoride monitors showed a continuing steady decline in concentrations, but levels near Hamilton Brick were well above objectives. Although there have been no public complaints of vegetation damage related to plant emissions, the company proposed a control technology which has received conditional Ministry approval.

Measurements of volatile organics such as xylene and toluene showed low levels across the city, well within guidelines. With the exception of benzene and naphthalene, traffic appeared to be the predominant source of these contaminants. Other semi-volatile organics known as polycyclic aromatic hydrocarbons (PAHs) exceeded guidelines for benzo(a)pyrene and levels were highest in the industrial zone and Beach Strip. Significant reductions between 35-60% were achieved in 1995. There are control programs at the major steel mills currently being implemented to reduce visible particulate emissions. These programs are expected to simultaneously reduce PAHs associated with coke oven operations. Benzene emission reduction programs are also expected to have a concurrent PAH reduction.

Airborne dust measurements near Redland Quarries, a limestone quarry in Flamborough, have shown clear improvements in dustfall and suspended particulate levels following the installation of new electrostatic precipitator at the company's processing plant and various other efforts to

control fugitive dust. However, suspended particulate measurements continued to show a localized problem with some measurements still above objectives immediately adjacent to the plant, probably due to fugitive dust emissions under higher wind speed conditions. The severity of the problem varies from year to year. The company conducted voluntary stack testing at the processing plant. The results of the tests will establish whether compliance with regulatory limits is being achieved and will be used in modelling to assess the impact of emissions on the surrounding community.

2. INTRODUCTION

The Air Management Program in Ontario is based on controlling man-made emissions to meet ambient air quality objectives, which in turn are based on known effects on health, quality of life, sensitive vegetation or materials, whichever is most stringent. To achieve these objectives, sources of pollution are identified, their emissions evaluated and appropriate control measures are instituted. Ambient air monitoring is used to identify pollution sources and to verify that controls have been successful. Monitors are usually sited in areas suspected of experiencing higher levels of air pollution. When these areas achieve acceptable air quality, then it is assumed that other areas should also be acceptable.

3. MONITORING NETWORK

The Ministry of the Environment operates a network of ambient air monitors throughout Hamilton as shown in Figure 1 and Table 1. The network centres on six automated stations which continuously monitor a variety of pollutants and telemeter hourly averaged data to a central computer facility in Toronto. These stations were:

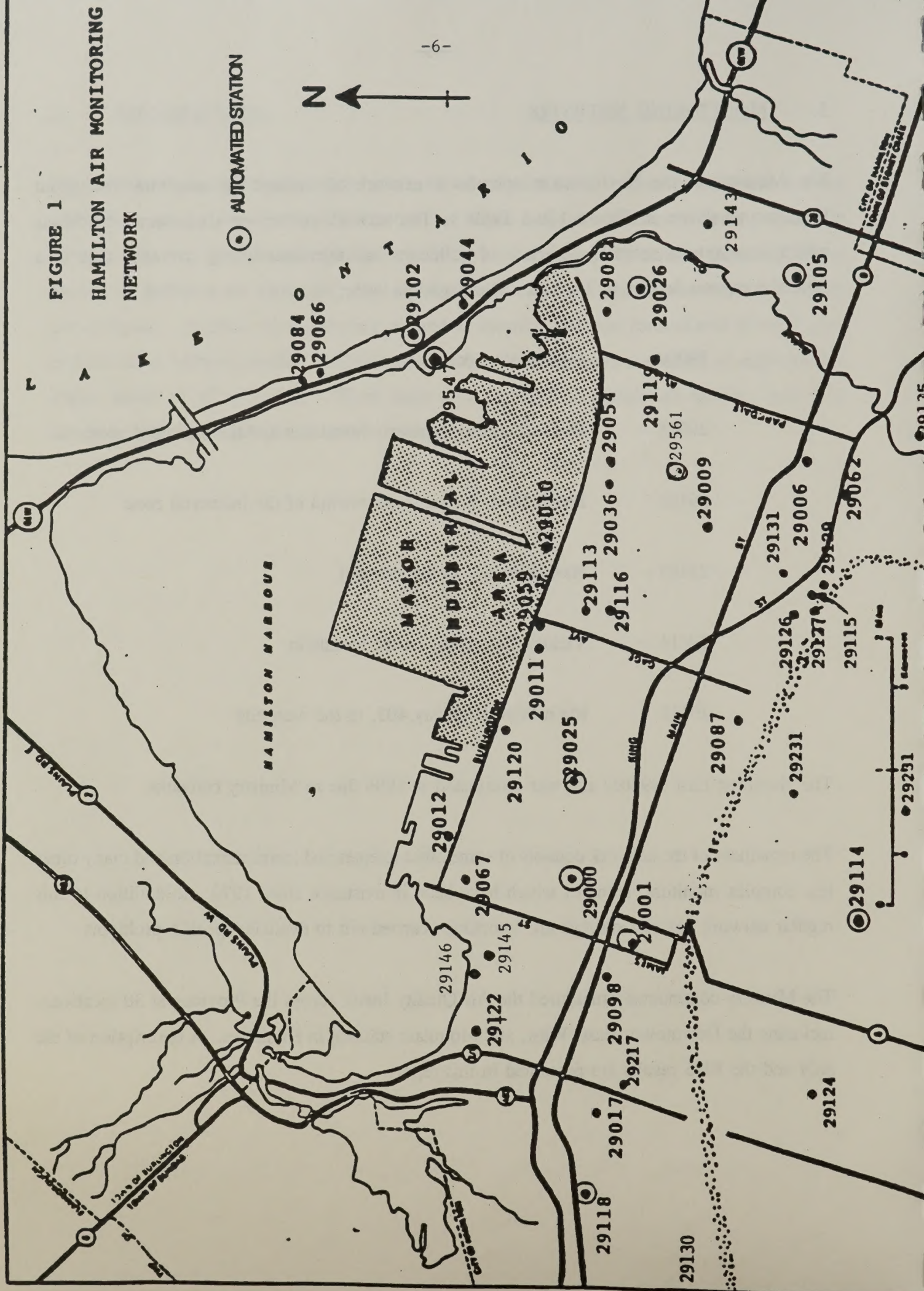
29000 -	Elgin/Kelly, downtown
29025 -	Barton/Sanford, between downtown and the industrial zone
29102 -	Beach Blvd, normally downwind of the industrial zone
29105 -	Nash/Kentley, in the east end
29114 -	Vickers/East 18th, on the mountain
29118 -	Main West/Highway 403, in the west end

The Hamilton East (29105) site was terminated in 1996 due to Ministry cutbacks.

The remainder of the network consists of some other telemetered instrumentation and many other less complex monitors, some of which have been in existence since 1970. In addition to this regular network, special surveys are sometimes carried out to evaluate specific problems.

The Ministry continuously measured the Air Quality Index across the Province at 30 locations, including the Downtown, East, West, and Mountain stations in Hamilton. A description of the AQI and the 1995 results are presented in this report.

HAMILTON AIR MONITORING NETWORK



It should be noted that some of the monitoring equipment in Hamilton was provided by Environment Canada under the National Air Pollution Surveillance (NAPS) program. The Ministry maintains and operates the equipment and reports/receives this data to/from Environment Canada.

TABLE 1
MONITORING NETWORK

STATION NUMBER	LOCATION	AQI	SO2	TSP	PM10	COH	TRS	O3	NOx	CO	DF	F	VOC	PAH	WIND	TEMP
29000	Elgin/Kelly	X	X	X	X	X	X	X	X	X	X	X	X			
29001	Hughson/Hunter					X										
29006	Queenston/Craigroyston					X										
29009	Kenilworth/Roxborough			X												
29010	Burlington/Ottawa			X												
29011	Burlington/Leeds			X												
29012	Burlington/Wellington															
29017	Chatham/Frid			X												
29025	Barton/Sanford		X	X		X	X									
29026	Woodward/Brampton															
29036	Roosevelt/Beach Rd															
29044	Wark/Beach Blvd															
29054	Beach Rd/Conrad															
29059	Burlington/Gage															
29062	King E/Barons															
29066	Killarney/Beach Blvd															
29067	Hughson N/Macauley			X												
29082	Leaside/ Knox															
29084	Rembe/Beach Blvd															
29087	Cumberland/Prospect			X												
29098	Bay/Main W			X												
29102	Beach Blvd/Towers		X	X	X	X	X		X		X		X			
29105	Nash/Kentley	X	X			X	X	X								
29113	Gertrude/Depew			X									X	X		

AQI - Air Quality Index SO2 - Sulphur Dioxide TSP - Total Suspended Particulate PM10 - Respirable Particulate COH - Soiling Index	TRS - Total Reduced Sulphur O3 - Ozone NOx - Nitrogen Oxides CO - Carbon Monoxide	DF - Dustfall F - Fluoride VOC - Volatile Organics PAH - Polycyclic Aromatic Hydrocarbons
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**TABLE 1 (cont'd)
MONITORING NETWORK**

STATION NUMBER	LOCATION	AQI	SO2	TSP	PM10	COH	TRS	O3	NOx	CO	DF	F	VOC	PAH	WIND	TEMP
29114	Vickers/E 18th	x	x	x	x	x	x	x	x			x	x	x		
29115	London/Justine											x				
29116	Dalkeith/Ottawa											x				
29118	Main W/Hwy 403	x	x	x		x	x	x	x							
29119	Morley/Parkdale															
29120	12 Dickson											x				
29122	Dundurn/York											x				
29124	Buchanan Park School															
29126	Rosslyn/Montclair											x				
29127	Lawrence/Balmoral											x				
29129	Province/Justine											x				
29130	Ewen/Whitney											x				
29131	Central/Graham															
29135	Albright/Mt Albion											x				
29143	Keefer Ct															
29145	Caroline/Barton										x					
29146	Stuart St										x					
29217	Chatham/Fanning										x					
29230	80 Cameo										x					
29231	Audrey/East 27th										x					
29547	Pier 25															
29561	Vansitmart/Strathearne		x			x	x						x	x		

AQI - Air Quality Index	TRS - Total Reduced Sulphur	DF - Dustfall
SO2 - Sulphur Dioxide	O3 - Ozone	F - Fluoride
TSP - Total Suspended Particulate	NOx - Nitrogen Oxides	VOC - Volatile Organics
PM10 - Respirable Particulate	CO - Carbon Monoxide	PAH - Polycyclic Aromatic Hydrocarbons
COH - Soiling Index		

4. ANALYSIS OF DATA

4.1 Air Quality Index (AQI)

The AQI is a system by which the public can be informed about air quality on a daily and even hourly basis. The index supplemented the old Air Pollution Index (API) which had been in place since 1970 and which still exists as a subindex of the AQI.

In the AQI, hourly concentrations of sulphur dioxide, soiling index (airborne particles), nitrogen dioxide, carbon monoxide, ozone and reduced sulphur compounds are all converted to a common scale of numbers. In addition to these hourly measurements, 8-hour average levels of carbon monoxide and the API, a 24-hour function of sulphur dioxide and particles are also included as subindices, making a total of eight potential subindices measured every hour. The official AQI broadcast is the highest subindex at that time.

The AQI scale is classified as follows:

0 - 15	Very Good
16 - 31	Good
32 - 49	Moderate
50 - 99	Poor
100+	Very Poor

Index levels up to 31 should have little or no effect on people and the environment. Beginning at the moderate level, effects such as odour, vegetation damage and some health effects to sensitive individuals start to occur.

In the poor and very poor categories, these symptoms become more and more acute, such that virtually all people would be hampered in the very poor range.

In 1995, the AQI's ozone subindex scale was adjusted to reflect new scientific information which

indicated human health effects due to ozone occurred at levels lower than previously thought. The concentration required to reach the Moderate range was reduced to 50 ppb from 80, and the Poor threshold reduced to 80 ppb from 120. This resulted in a significantly increased number of hours in the Moderate and Poor ranges.

New scientific information is also becoming available on the health impacts of inhalable particles. The Ministry is developing a standard which will be reflected in the AQI.

When moderate AQI levels or higher are measured, public health advisories can be issued to the public along with the actual index number, particularly for ozone generated indices.

Statistics on hourly frequencies for 1995 for each pollutant in the five concentration categories for the four Hamilton stations are presented in Table 2.

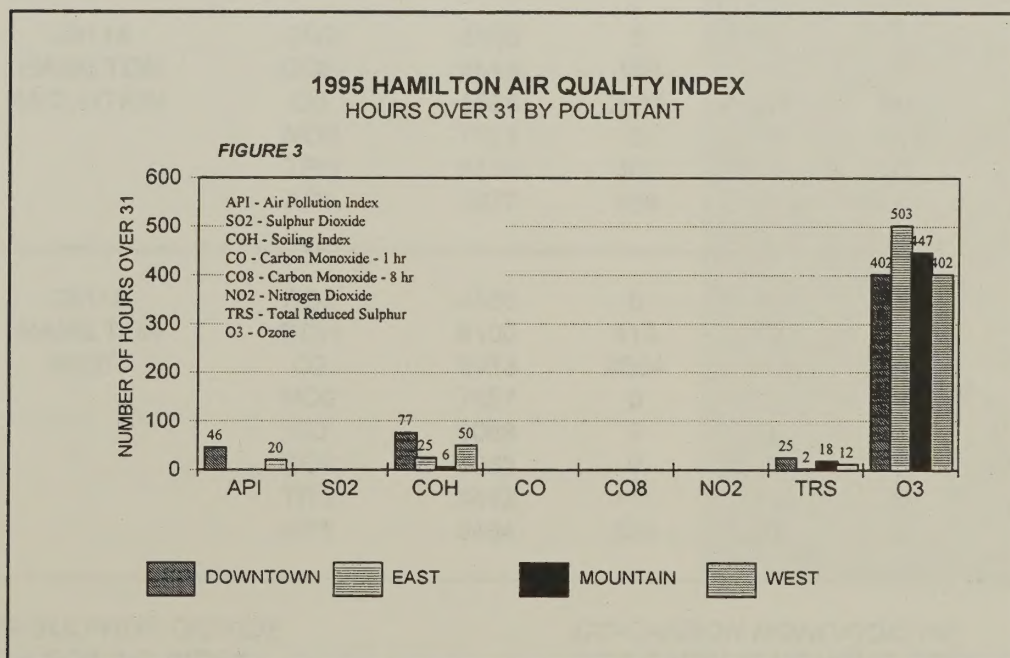


Figure 3 graphically displays the numbers of index hours in the Moderate or higher ranges for each station and for each sub-index. As can be seen, ozone dominated the index, all during the spring and summer, but suspended particles (COH) ,the Air Pollution Index and total reduced sulphur were also problematic pollutants reaching the Moderate range. The downtown station had the greatest number of hours for the latter three pollutants (among the AQI stations) , while the east end site was the leader for ozone by a small margin.

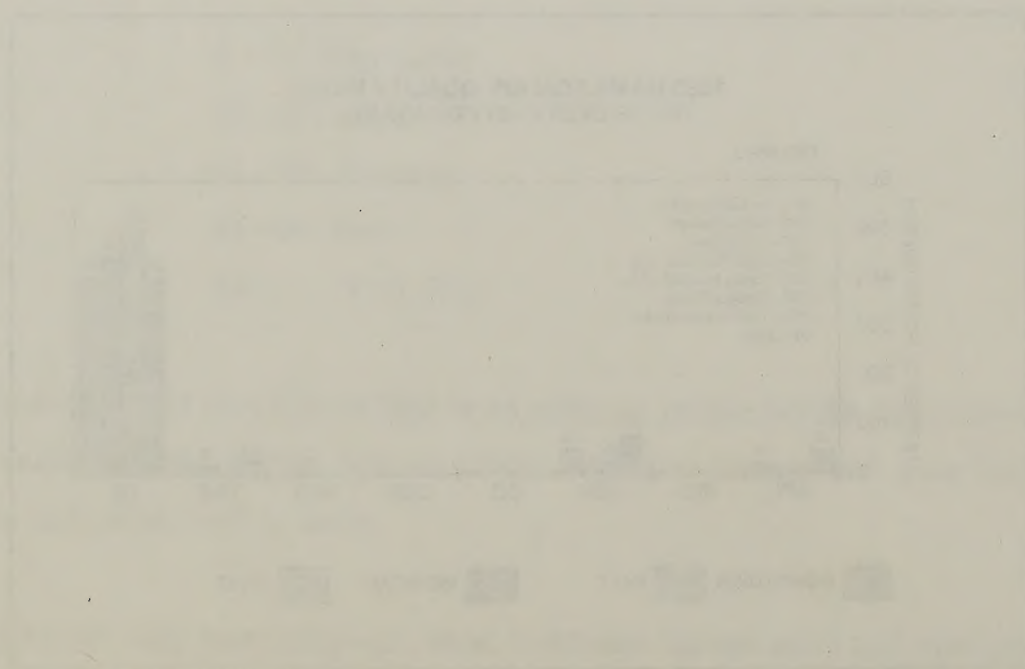


TABLE 2
AIR QUALITY INDEX - 1995
HOURLY FREQUENCY DISTRIBUTION

POLLUTANT		0-15 Very Good	16-31 Good	32-49 Moderate	50-99 Poor	100+ Very Poor
29000 HAMILTON DOWNTOWN	SO2	8686	0	0	0	0
	COH	8133	412	77	0	0
	O3	5975	2309	375	27	0
	NO2	7790	0	0	0	0
	CO	8684	0	0	0	0
	CO8	8684	0	0	0	0
	TRS	8441	112	23	2	0
	AP1	6321	820	46	0	0
29105 HAMILTON EAST	SO2	8656	0	0	0	0
	COH	8317	251	25	0	0
	O3	5594	2543	466	37	0
	TRS	8544	8	1	1	0
	AP1	6908	302	0	0	0
29114 HAMILTON MOUNTAIN	SO2	8515	0	0	0	0
	COH	8513	100	6	0	0
	O3	5538	2611	414	33	0
	NO2	7721	0	0	0	0
	TRS	8504	62	18	0	0
	AP1	7077	159	0	0	0
29118 HAMILTON WEST	SO2	8580	0	0	0	0
	COH	8100	418	50	0	0
	O3	5933	2304	368	34	0
	NO2	7857	0	0	0	0
	CO	8068	0	0	0	0
	CO8	8068	0	0	0	0
	TRS	8442	111	11	1	0
	AP1	6454	534	20	0	0

SO2-SULPHUR DIOXIDE
COH-SOILING INDEX
O3-OZONE
NO2-NITROGEN DIOXIDE

CO-CARBON MONOXIDE(1hr)
CO8-CARBON MONOXIDE(8hr)
TRS-TOTAL REDUCED SULPHUR
API-AIR POLLUTION INDEX

4.2 Air Pollution Index

The Hamilton air pollution index (API) continued to be used as a warning system to alert the public to elevated air pollution levels and as a trigger for cutbacks in industrial emissions. It is derived from 24-hour average concentrations of sulphur dioxide and particulate matter. The combination of these two pollutants at elevated levels is indicative of detrimental human health effects. Hourly concentrations of both pollutants are telemetered to a central computer facility in Toronto which then calculates the index each hour, based on the following equations:

$$\text{Downtown} \quad \text{API} = 1.47 (16.4 \text{ COH} + 122.9 \text{ SO}_2)^{.92}$$

$$\text{East} \quad \text{API} = 2.68 (11.0 \text{ COH} + 122.2 \text{ SO}_2)^{.79}$$

$$\text{West} \quad \text{API} = 2.84 (10.8 \text{ COH} + 120.9 \text{ SO}_2)^{.77}$$

$$\text{Mountain} \quad \text{API} = 2.68 (11.0 \text{ COH} + 122.2 \text{ SO}_2)^{.79}$$

Where: COH is the 24-hour average soiling index concentration expressed in coefficient of haze units.

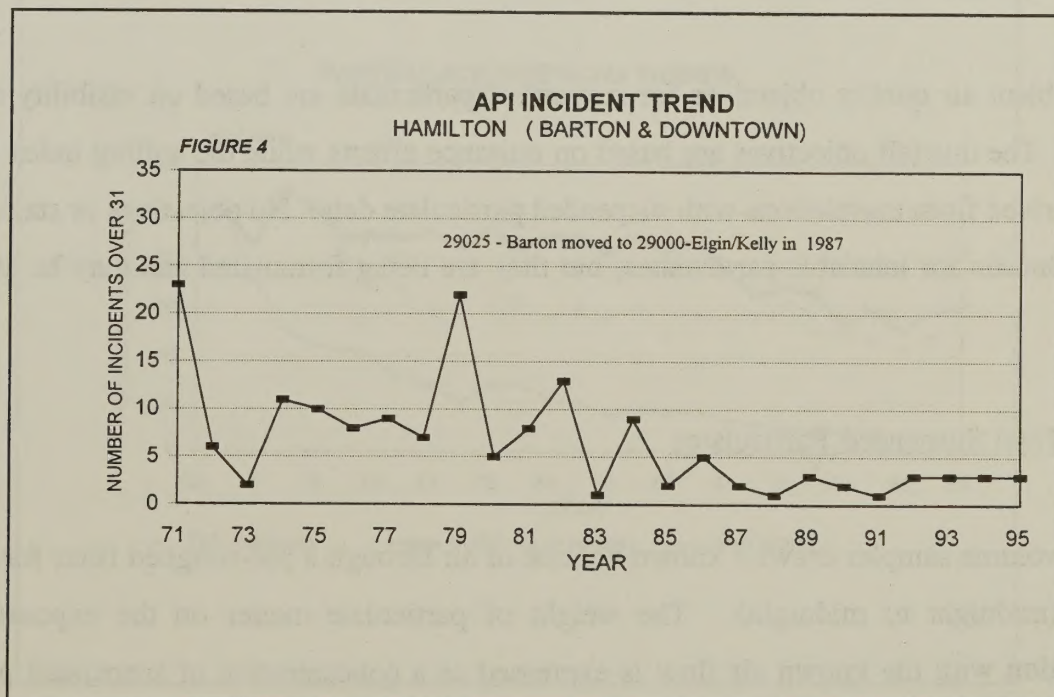
SO₂ is the 24-hour average of sulphur dioxide concentration expressed in parts per million.

No action is taken for readings up to 31. At 32, known as the advisory level, and with a forecast of unfavourable dispersion conditions, major industries in Hamilton are notified and asked to voluntarily curtail certain operations. At an API of 50, cutbacks by these sources become mandatory. These levels are set with a considerable safety margin before health effects to sensitive people would be expected. At 75, further cutbacks would be ordered, and at 100 all sources not essential to public health and safety could be ordered to cease operations.

During 1995, there were three times when the API reached Moderate at the downtown site; occurring January 14-15, June 2-3 and October 24, peaking at 39, 34 and 35 respectively. The other stations recorded lower levels with the east end peaking at 17-26, the mountain 14 -26 and the west end 18-37 during these incidents. The west site was the only other station to exceed 31 - during the January event.

The incidents were all a result of the classical lake breeze phenomenon, in which a warm southerly air mass was undercut by a cool northeast breeze off a cold Lake Ontario resulting in a temperature inversion.

There used to be a high variability in the numbers of incidents each year, a variability that was weather related, ie. related to the frequency of typical inversion conditions. However, there has been a general decline in the frequency of these incidents (Figure 4) such that since 1987, one to three API incidents occur each year at any one location, mostly at the Downtown site. The improvement can be credited to the success of abatement actions by industry and pollution controls on vehicles.



4.3 Particulates

There are five types of instruments routinely employed for the measurement of particles, each type relating to a different size range:

- a) Dustfall jars measuring heavy material, generally greater than 10 microns in diameter (one micron is one millionth of a metre).
- b) High volume samplers measuring suspended particulates ranging in size from submicron to 50 microns.
- c) Co-efficient of haze (soiling index) hourly tape samplers measuring mostly fine material - from submicron to about 10 microns.
- d) High volume samples measuring inhalable particulates less than 10 microns.
- e) Continuous particulate samplers measuring inhalable particulates less than 10 microns.

The ambient air quality objectives for suspended particulate are based on visibility and health effects. The dustfall objectives are based on nuisance effects while the soiling index objectives were derived from correlations with suspended particulate data. No objectives or standards exist yet in Ontario for inhalable particulates, but they are being formulated and may be available in 1997.

4.3.1 Total Suspended Particulates

A high volume sampler draws a known volume of air through a pre-weighed filter for a 24 hour period (midnight to midnight). The weight of particulate matter on the exposed filter in conjunction with the known air flow is expressed as a concentration of suspended particles in air in micrograms per cubic meter. The objective for a 24-hour average is 120 ug/m³ while the yearly geometric mean objective is 60 ug/m³.

There were 19 hivol stations in 1995 and each ran simultaneously, once every six days, consistent with the practice in other North American jurisdictions. This means that each day of the week is sampled in sequence, i.e. Sunday, next Saturday, next Friday, etc.

Suspended particulate data is summarized in Table 3a and shows a definite gradient of higher concentrations closer to the industrial area.

The overall trend in TSP since 1970 is shown in Figure 5. It had displayed a steady decline in concentrations, however, the levels increased again in 1994 and 1995 returning to those measured in the mid to late 1980s.

On average, 1995 levels were 28% higher than those of 1993. This increase coincides with a "black fallout" problem which emerged in the City.

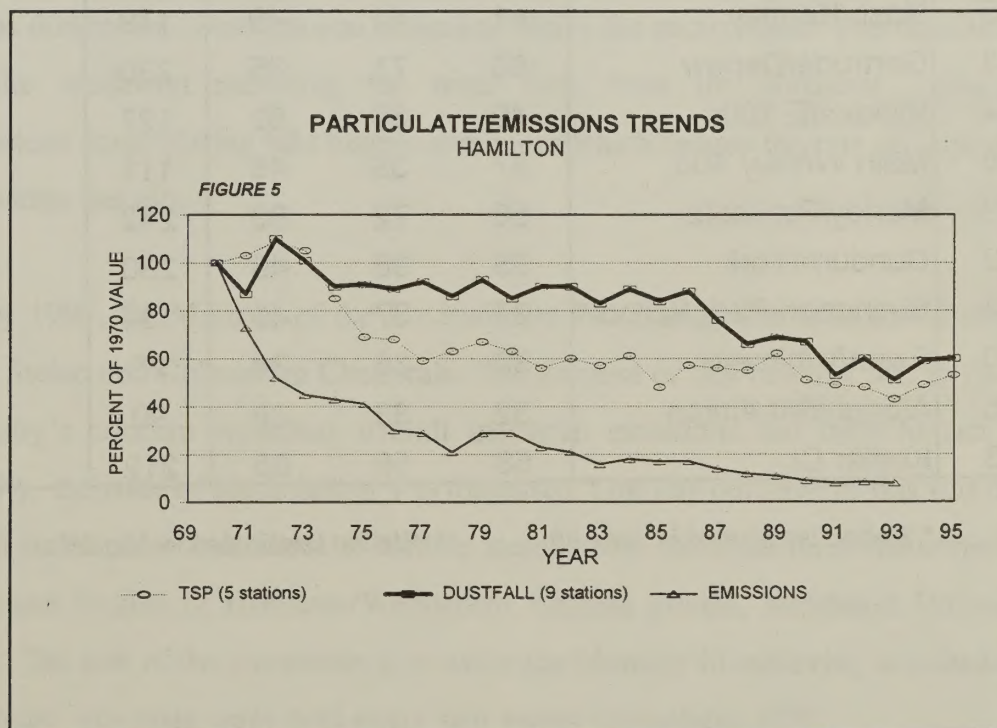


TABLE 3a
SUSPENDED PARTICULATES

Ontario Objectives: 120 ug/m3 (24 hr)
60 ug/m3 (1 yr geo.mean)

micrograms per cubic metre

STATION NUMBER	LOCATION	GEOMETRIC MEAN			MAX 1995	% SAMPLES > 120 (1995)
		1993	1994	1995		
29000	Elgin/Kelly	53	60	51	158	7
29009	Kenilworth/Roxborough	45	50	55	115	0
29011	Burlington/Leeds	81	75	88	232	23
29017	Chatham/Frid	57	68	87	319	22
29025	Barton/Sanford	56	60	71	205	10
29067	Hughson N/Macauley	40	40	53	216	5
29087	Cumberland/Prospect*	47	54	56	110	0
29098	Bay/Main W	40	44	51	172	3
29102	Beach Blvd/Towers	57	66	70	194	29
29105	Nash/Kentley	41	41	49	179	2
29113	Gertrude/Depew	63	71	85	230	24
29114	Vickers/E 18th	40	39	52	127	2
29118	Main W/Hwy 403	37	39	48	111	0
29119	Morley/Parkdale	59	72	80	242	21
29122	Dundurn/York	35	36	46	260	5
29124	Buchanan Park School*	37	37	49	134	5
29130	Ewen/Whitney+	30	35	34	98	0
29135	Albright/Mt Albion	32	33	38	90	0
29143	Keefer Ct	58	59	65	212	10

* Station terminated in June 95

*+Station terminated in Aug 95

A contour map of suspended particulate concentrations (yearly average) is given in Figure 6. It can be seen that the majority of the city met the yearly objective of 60 ug/m^3 . Concentrations were only elevated close to the industrial area. Beyond this area, concentrations were fairly uniform across the city.

It should be realized that these contour maps of concentrations are a very general picture of city wide air quality. Local influences affect some of the stations, and several more stations would be required to fill in some gaps.

Figure 6 reflects long term average conditions. A different situation exists during inversion conditions, with poor dispersion, when pollution from all sources, including traffic and industry, can accumulate and will contribute to the totals.

Figure 7 depicts suspended particulate contours during an elevated Air Pollution Index incident on June 2, 1995. The 24 hour objective is 120 ug/m^3 . The map displays increased pollution concentrations across most of the city, with a central plume reaching from the industrial complex toward the downtown, west end and extending above the escarpment. The contours are skewed toward the southwest reflecting the wind flow from the northeast. These increased concentrations occur during lake breeze inversions which reduce the rate of dispersion from all sources within the city.

In January 1995, the Minister of the Environment and Energy met with senior management of Dofasco, Stelco and Columbian Chemicals. The purpose of this meeting was to clearly identify the Ministry's concern regarding overall industrial emissions and their impact on citizens. Specifically, the issue of black fallout was discussed. One key outcome of this was the formation of a multi-stakeholder committee to include membership from the three industries, the City of Hamilton and Region of Hamilton/Wentworth, citizens groups, McMaster University and the Ministry. The aim of the committee is to assist the Ministry in achieving sustainable air quality improvement. Meetings were held every two weeks throughout 1995.

FIGURE 6

ISOPLETHS OF 1995
SUSPENDED PARTICULATE
GEOMETRIC MEANS
MICROGRAMS PER CUBIC METRE

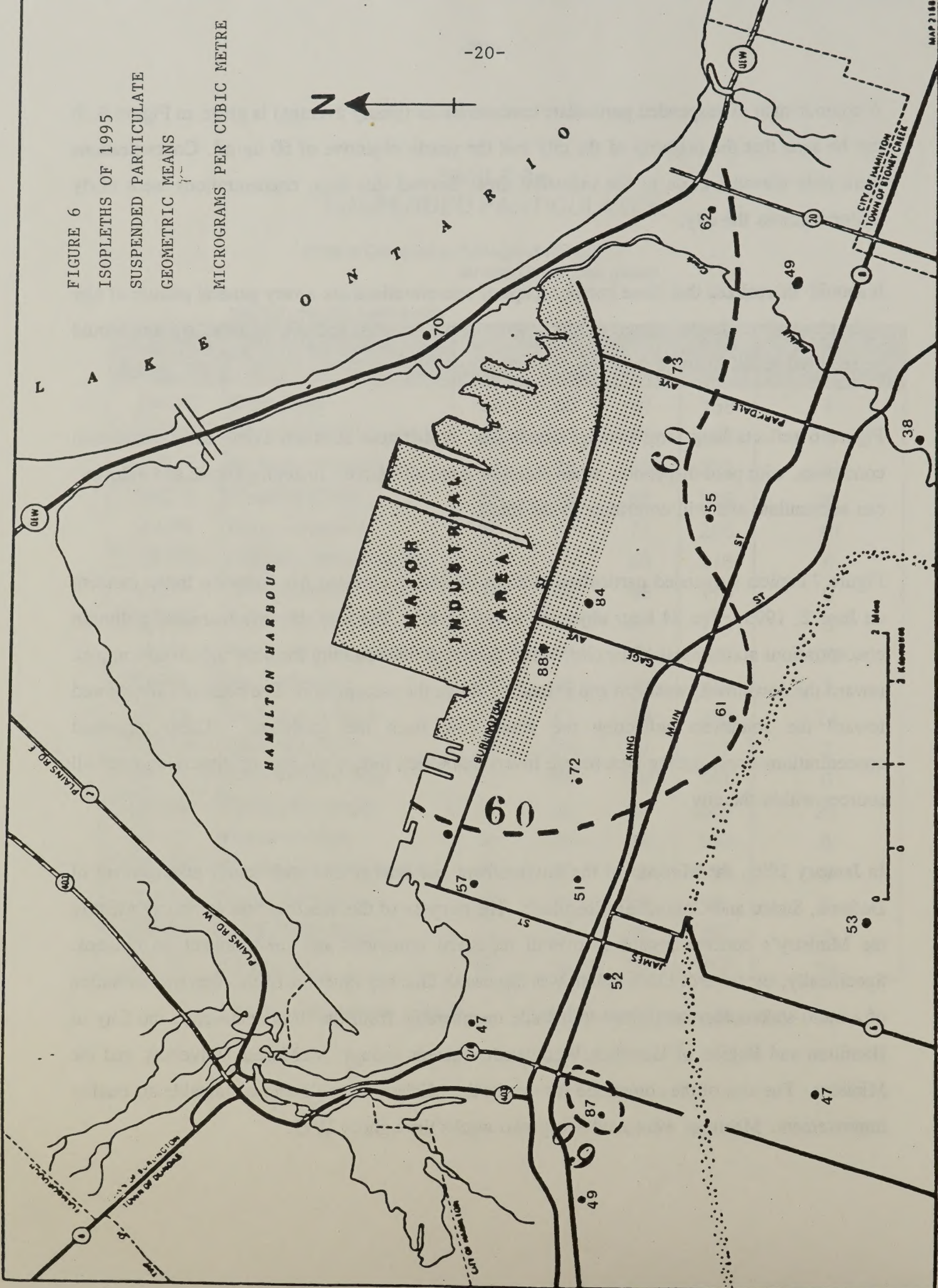


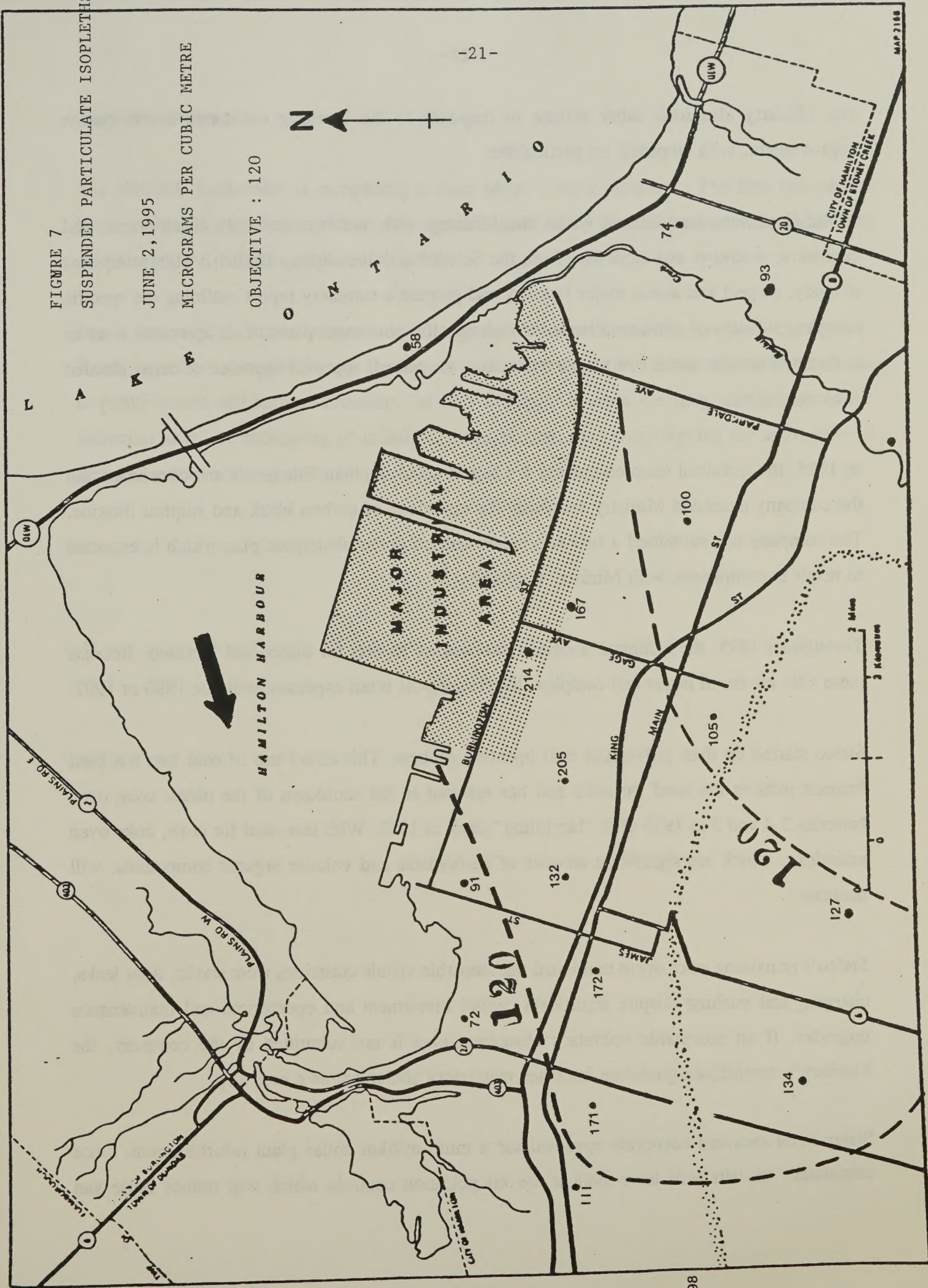
FIGURE 7

SUSPENDED PARTICULATE ISOPLETH

JUNE 2, 1995

MICROGRAMS PER CUBIC METRE

OBJECTIVE : 120



The Ministry also took other actions in response to the levelling out trend in air quality improvement, with emphasis on particulates.

A technical team was formed within the Ministry with members from the local office, and engineers, scientists and modellers from the Science and Technology Branch. This group was to study, inspect and assess major industry and prepare a summary report outlining the specific company's issues of non-compliance through specific abatement plans. This approach is novel in that it views the site as one source rather than the normal approval approach of many isolated sources.

In 1995, the technical team completed its report on Columbian Chemicals and concluded that the company exceeded Ministry standards for emissions of carbon black and sulphur dioxide. The company has submitted a two year multi-million dollar abatement plan which is expected to result in compliance with Ministry standards.

Throughout 1995, the technical team also worked on reports for Stelco and Dofasco. Because these sites are much larger and complex, the final report is not expected until late 1996 or 1997.

Stelco started up their pulverized coal injection process. This direct use of coal into the blast furnace reduces the need for coke and has resulted in the shutdown of the oldest coke oven batteries 3,4 and 5 in 1996 after "hot idling" them in 1995. With less need for coke, coke oven emissions, which are significant sources of particulates and volatile organic compounds, will decrease.

Stelco's remaining coke ovens continued unacceptable visible emissions from stacks, door leaks, charging and pushing despite significant capital investment and operational and maintenance upgrades. If an acceptable voluntary abatement plan is not submitted by the company, the Ministry's compliance guideline indicates mandatory abatement as a next step.

Slater Steel received corporate approval for a multi-million dollar plant refurbishment. Once completed, the site will have state of the art pollution controls which will reduce noise and

particulate emissions.

The SWARU incinerator is completing a three phase control program. The first two phases have resulted in compliance with visible emission standards. The third phase will address acid gas releases and will be completed by 1997.

Inside company properties, programs are in operation to control roadway sources of particulate. Roads have been paved and road cleaning is performed regularly. Better control of track-out to public streets still appears necessary, as well as improved street cleaning, particularly in the industrial area. Landscaping of industrial properties has also been ongoing for some time in order to reduce wind blown or fugitive dust.

4.3.2 Inhalable Particulate (PM10)

Inhalable particulate is defined as particles less than 10 microns in diameter. A micron is one millionth of a metre. These particles can penetrate into the human lung and research has shown a correlation between mortality and other health effects, and concentrations of these particles. Standards do not exist yet in Ontario, but are being formulated.

There are now two measures of this parameter. The first methodology is similar to that for suspended particulates, utilizing a high volume sampler outfitted with a special size fractionating head, which permits the sampling of particles 10 microns and less in size. Quartz filters are used instead of glass fibre.

The measurements were begun in 1991 at four sites and tended to mirror the suspended particulate results which were measured alongside. Data are summarized in Table 3b and Figure 8 gives a visual indication of the spatial variations. Similar to other particle measurements, concentrations are highest in the industrial zone. Station 29313- Gertrude/Depew showed the highest mean at 33 ug/m³. The Mountain, Downtown, Beach and Homeside sites were fairly similar in the 20-24 ug/m³ range. The levels have been fairly steady over the four years. It should be noted that the Homeside geometric mean is an estimate based on the annual average measured by a continuous monitor, to be discussed below.

The respirable particulate fraction generally comprised about 40% of the total suspended particulate loadings, but the Beach site averaged only 30%. This means that there are more larger particles in the air on average at the Beach.

The second methodology involves continuous sampling of PM10. Electronic instrumentation yields hourly particulate concentrations in real time. There actually two kinds of monitors. One is known as a beta gauge and uses the principle of beta radiation attenuation by particles. The other monitor involves the sensing of minute changes in the vibration of a filter collecting particles. Both methods yield comparable data and have been shown to compare favourably to the high volume filter sample methodology.

TABLE 3b INHALABLE PARTICULATES

PARTICULATE LESS THAN 10 MICRONS IN DIAMETER
BY SIZE SELECTIVE INLET HIVOL SAMPLING

micrograms per cubic metre

YEAR	NUMBER OF SAMPLES	ANNUAL AVERAGE	GEOMETRIC MEAN	MAXIMUM 24 HR
29300 - Elgin/Kelly				
1995	53	24	20	88
1994	54	30	26	96
1993	57	27	22	97
1992	57	29	26	80
29302 - Beach Blvd				
1995	54	26	22	63
1994	54	29	25	65
1993	53	33	27	130
1992	54	25	22	71
29313 - Gertrude/Depew				
1995	52	37	33	88
1994	53	37	34	90
1993	49	33	26	104
1992	55	35	32	110
29324 - Laurier/Columbia				
1995	42	25	21	94
1994	34	22	20	39
1993	53	22	18	79
1992	35	25	22	72

INHALABLE PARTICULATES

PARTICULATE LESS THAN 10 MICRONS IN DIAMETER
BY CONTINUOUS HOURLY SAMPLING

micrograms per cubic metre

YEAR	ANNUAL AVERAGE	MAXIMUM 1 HOUR	MAXIMUM 24 HOUR
29000 - Elgin/Kelly			
1995	29	554	127
1994	27	684	157
29561 - Vansitmart Ave.			
1995*	28	308	94
1994+	28	262	71

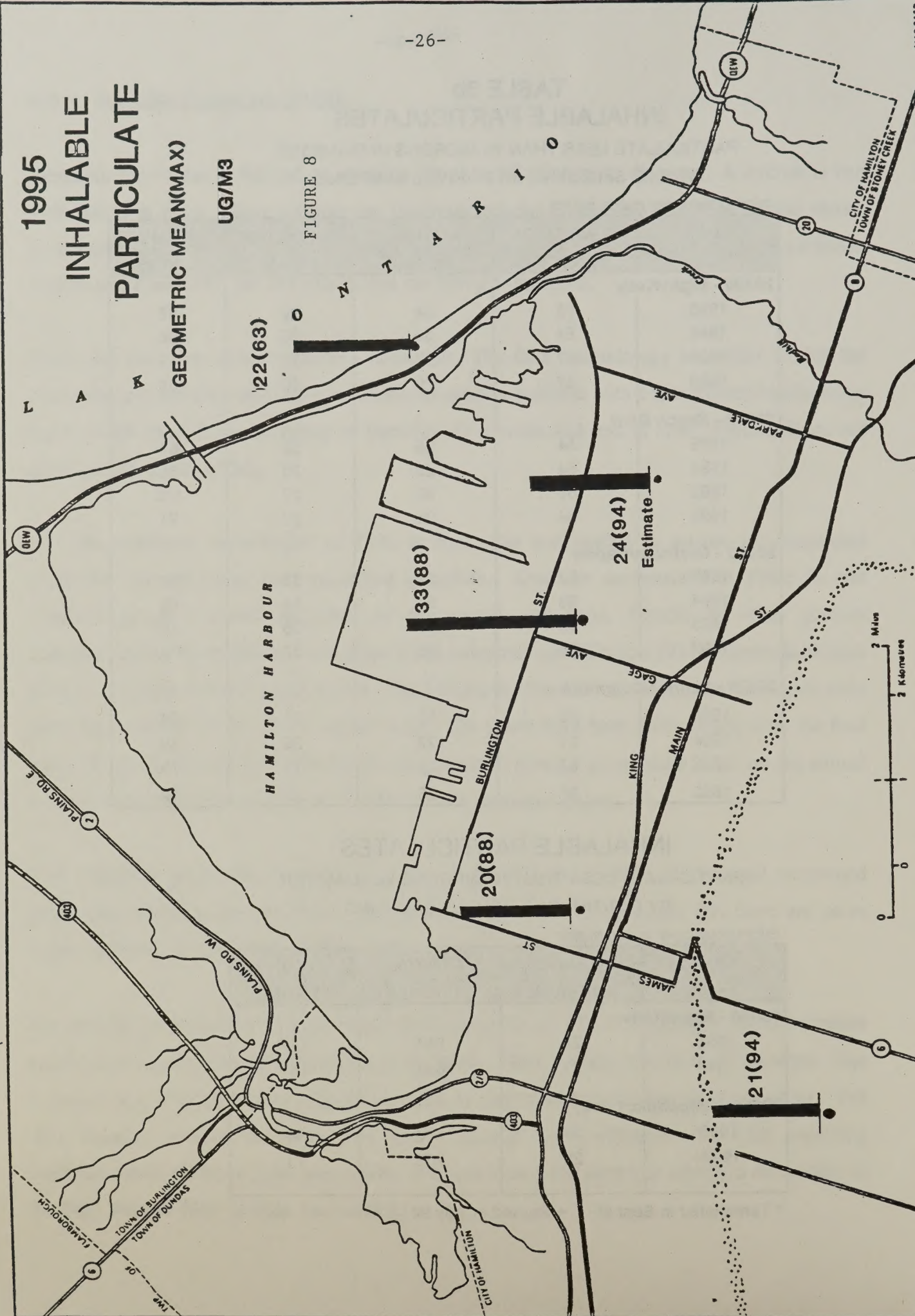
* Terminated in Sept 95 + Started in July 94

1995 INHALABLE PARTICULATE

GEOMETRIC MEAN(MAX)

UG/M3

FIGURE 8



A beta gauge was located in the Homeside neighbourhood at 29561 - Vansitmart, beginning in mid 1994, specifically to monitor the black fallout problem. The annual average of 28 ug/m³ was similar to downtown station 29000-Elgin/Kelly, however, the data indicated that elevated concentrations coincided most frequently with winds from the northeast. Together with source modelling which indicated that Columbian Chemicals was out of compliance with regulatory standards, this prompted a control program by the company, as discussed previously. The work of the Ministry's technical team will address overall particulate emissions, including PM₁₀. As well, the Air Quality Stakeholder Committee is expected to deliver long term sustainable air quality improvement.

It should be noted that the downtown particulate monitor was provided by Environment Canada as part of its nation-wide urban monitoring program.

4.3.3 Soiling Index (Co-efficient of Haze)

Co-efficient of haze tape samplers operate continuously and determine hourly soiling values. Air is drawn through a filter paper, and the optical density of the soiled spot is measured by light transmittance. The instrument takes readings prior to and after sample collection. The resultant light obstruction was determined and transmitted on a real time basis to the data bank for the eight telemetered stations. Data are given in Table 4.

In 1995, the yearly objective was marginally exceeded at two of the eight stations. Higher averages corresponded to locations closer to traffic arteries and the industrial zone. Levels on average were 14% lower compared to 1993, which was in direct contrast to suspended particulates which rose and dustfall and inhalable particulate measurements which remained unchanged. The monitor on Vansitmart Ave, near the industrial zone in the Homeside neighbourhood recorded an acceptable average lower than five other stations. However, there were elevated readings which coincided with the continuous PM₁₀ readings.

TABLE 4
SOILING INDEX

COHs/1000 linear feet of air

YEAR	ANNUAL AVERAGE	MAXIMUM 24 HOUR	Days Above 24 hr Objective
29000 - Elgin/Kelly			
1995	0.39	1.7	10
1994	0.47	1.8	17
1993	0.48	1.7	19
29001 - Hughson/Hunter			
1995	0.55#	2.1	17
1994	0.54	2.8	24
1993	0.56	2.2	34
29025 - Barton/Sanford			
1995	0.48	1.8	16
1994	0.54	2.2	21
1993	0.59	2.0	34
29102 - Beach Blvd			
1995	0.54	1.8	28
1994	0.59	2.1	24
1993	0.56	1.8	27
29105 - Nash/Kentley			
1995	0.42	1.4	3
1994	0.47	1.7	6
1993	0.50	2.0	12
29114 - Vickers/East 18th			
1995	0.24	1.1	1
1994	0.28	1.2	1
1993	0.31	1.6	6
29118 - Main West			
1995	0.35	1.8	9
1994	0.38	1.8	13
1993	0.42	1.7	14
29561 - Vansitmart Ave.			
1995	0.36+	1.1	2
1994	0.38*	1.8	13

Ontario Objectives: 1.0 COHs/1000 ft (24 hour)
0.5 COHs/1000 ft (annual average)

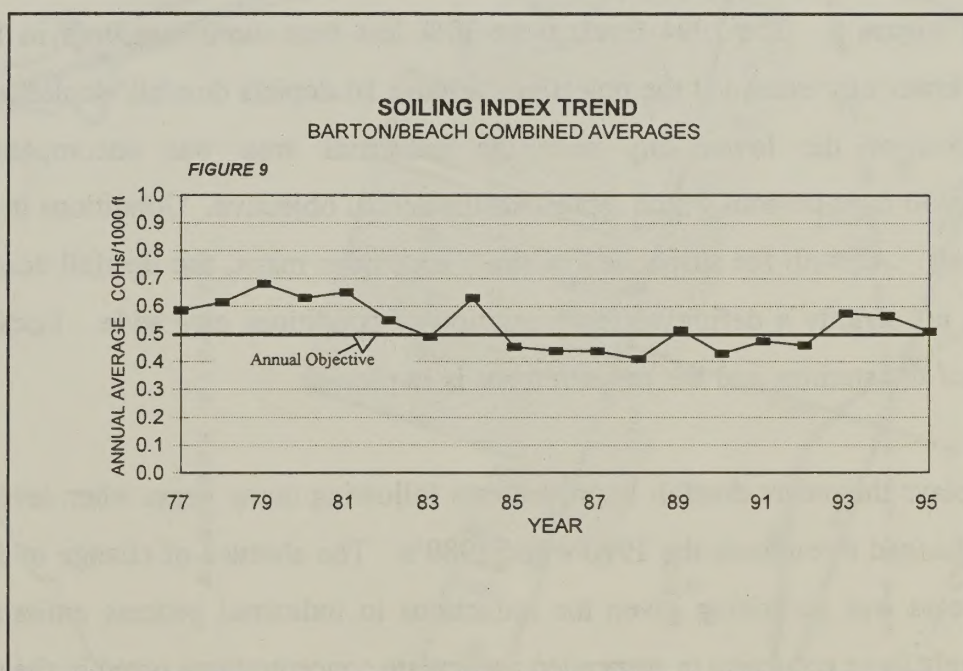
Terminated in Aug 95

* Oct -Dec 94 only

+ Terminated in Sep 95

The daily objective was exceeded to varying degrees - from 28 days at 29102 - Beach Blvd to one day at the mountain site. There were fewer such daily exceedances at all stations than in 1994.

Figure 9 illustrates the long term trend measured at Barton/Sanford and Beach Blvd -the longest established sites. Stable levels hovering around the objective level, with only a very slight decline are evident since 1977. This tends to indicate that non-industrial sources, particularly vehicles, affect these measurements significantly at these locations.



The Air Quality Index stations each recorded hourly COH levels in the moderate range of the AQI (Tables 2 and Figures 3). Downtown (Elgin/Kelly) measured 77 moderate hours, East (Nash/Kentley) measured 25 moderate hours; West (Main West) 50 moderate hours and the mountain (Vickers) 6 moderate hours. These were all improvements from 1994. Many of these readings occurred during morning rush hours and/or during inversions, although the west station tended to measure some higher levels in late evening hours. Traffic was probably a major contributor to these readings.

4.3.4 Dustfall

Dustfall is that material which settles out of the atmosphere by gravity. It is collected in plastic containers during a 30 day exposure time. The collected material is weighed and expressed as a deposition rate of grams/square metre/30 days. The significance of observations is restricted to relatively local areas and dustfall objectives are based on visible deposit of dust rather than health effects.

Dustfall levels in 1995 (Table 5a) were unchanged from 1994, but the overall trend is downward as shown by Figure 5. The 1994 levels were 30% less than those measured in 1986. Still, some of the lower city exceeded the objective. Figure 10 depicts dustfall isopleths, and shows that a portion of the lower city near the industrial area was encompassed by the 4.5 grams/m²/30 days contour which represents the annual objective. Conditions in parts of this area were poor. As with the suspended particulate contour maps, the dustfall contour map in Figure 10 is not strictly a definitive representation of conditions city wide. Local influences affect some of the stations and the measurement is imprecise.

Figure 5 displays the recent dustfall improvements following many years when levels remained virtually unchanged throughout the 1970's and 1980's. The absence of change in dustfall over the earlier years was surprising given the reductions in industrial process emissions and the correspondingly large reduction in suspended particulate concentrations noted in the same graph. Fugitive dust sources such as road dust, stock piles, unpaved areas, vehicle emissions, etc. are probably important in explaining this observation. The reductions in the late 1980s represent the first significant improvement in dustfall levels in many years.

Five dustfall stations were routinely analyzed for a scan of 10 metals (Table 5b). The most prominent metals were iron and manganese followed by copper and zinc, each showing a strong gradient with distance from the industrial zone with the exception of copper and zinc which for unknown reasons showed higher averages on the mountain at 29230.

Only one of the metals has an objective - lead, and it was not exceeded at any of the stations.

FIGURE 10
ISOPLETHS OF 1995
DUSTFALL ANNUAL AVERAGES
grams/sq.m./30 days

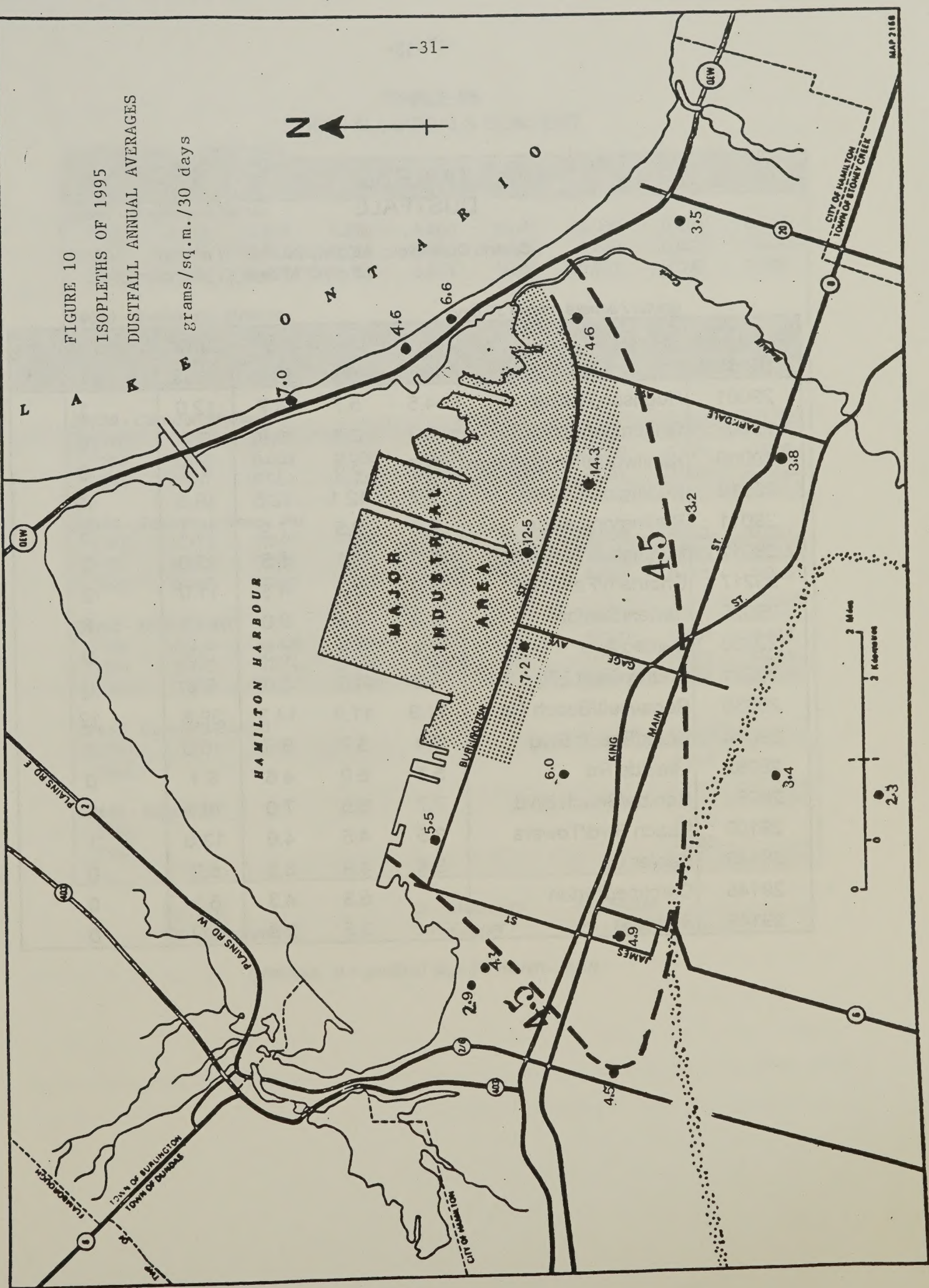


TABLE 5a
DUSTFALL

Ontario Objectives: 7.0 g/m²/30 days (1 month)
4.5 g/m²/30 days (1 year average)

grams / square metre/ 30 days

STATION NUMBER	LOCATION	AVERAGE			MAX 1995	No. of Months > 7.0 (1995)
		1993	1994	1995		
29001	Hughson/Hunter	4.5	5.7	4.9	12.0	1
29006	Queenston Rd	3.2	3.5	3.8	6.7	0
29009	Kenilworth/Roxborough	3.0	3.8	3.2	4.6	0
29010	Burlington/Ottawa	9.2	12.1	12.5	19.0	10
29011	Burlington/Leeds	7.8	9.5	7.2	12.1	5
29012	Burlington/Wellington	5.0	6.1	5.5	12.0	2
29217	Chatham/Fanning	5.0	3.2	4.5	11.0	2
29025	Barton/Sanford	4.4	4.5	6.0	14.0	3
29230	Cameo Ave	4.4	2.5	2.3	3.3	0
29231	Audrey/East 27th	3.0	4.0	3.4	6.8	0
29036	Roosevelt/Beach Rd	11.9	11.9	14.3	39.6	12
29044	Wark/Beach Blvd	5.4	5.7	6.6	16.0	4
29082	Leaside Rd	5.1	5.0	4.6	6.1	0
29084	Rembe/Beach Blvd	7.7	8.5	7.0	16.0	4
29102	Beach Blvd/Towers	3.5	4.5	4.6	13.0	1
29143	Keefer Ct	3.5	4.9	3.5	5.2	0
29145	Caroline/Barton		5.3	4.3	6.1	0
29146	Stuart St		3.5	2.9	4.9	0

TABLE 5b
DUSTFALL METALS CONTENT

grams/square metre/30 days

	Fe	Mn	Co	Cr	Cu	Ni	Pb	Zn
YEARLY AVERAGES								
29001 - Hughson/Hunter								
1995	0.250	0.013	0.000	0.000	0.001	0.000	0.001	0.007
1994	0.151	0.012	0.000	0.001	0.002	0.000	0.002	0.005
1993	0.152	0.007	0.001	0.001	0.001	0.001	0.002	0.006
29010 - Burlington/Ottawa								
1995	0.454	0.047	0.000	0.002	0.001	0.000	0.002	0.007
1994	0.483	0.041	0.000	0.002	0.001	0.000	0.003	0.015
1993	0.490	0.016	0.001	0.002	0.001	0.001	0.002	0.012
29230 - Camden/Mohawk								
1995	0.029	0.003	0.000	0.000	0.005	0.000	0.000	0.014
1994	0.045	0.003	0.000	0.000	0.006	0.000	0.001	0.016
1993	0.087	0.002	0.000	0.000	0.007	0.001	0.001	0.012
29036 - Roosevelt/Beach Rd								
1995	0.342	0.049	0.000	0.002	0.004	0.000	0.003	0.027
1994	0.383	0.038	0.000	0.001	0.003	0.000	0.003	0.025
1993	0.455	0.020	0.000	0.002	0.003	0.001	0.003	0.025
29102 - Beach Blvd								
1995	0.097	0.009	0.000	0.000	0.002	0.000	0.001	0.018
1994	0.145	0.014	0.000	0.001	0.001	0.000	0.001	0.005
1993	0.119	0.004	0.000	0.001	0.001	0.001	0.001	0.007
29145 - Caroline/Barton								
1995							0.018	
1994							0.029	
29146 - Stuart St								
1995							0.002	
1994							0.002	

Fe - Iron

Mn - Manganese

Cr - Chromium

Cu - Copper

Ni - Nickel

Pb - Lead

Objective: 0.1 g/m2/30 days (1 month - lead)

Lead in dustfall varied little across the City, similar to the pattern found in suspended particulates. The metals cadmium, cobalt, chromium, nickel and vanadium did likewise.

Two stations (29145 and 29146) were placed near B&M Metals on Caroline St. N., a furnacing facility which includes some lead smelting. Concerns were expressed regarding lead emissions so samples were analyzed for lead. The averages are shown in Tables 5a and 5b. There were no total dustfall exceedances at either station. The 29145 station was immediately adjacent to the company and recorded higher than normal lead levels compared to both the city as a whole and the control site 29146. Therefore, the company does appear to have a small localised lead impact, however, the lead concentrations were far below the monthly objective. Stack testing also indicated that emissions comply with the lead standard, but the company is planning to install improved emission control equipment to further reduce lead emissions.

The dustfall improvements in recent years are largely due to numerous abatement efforts. City staff modified road cleaning practices. Industry has continued to control fugitive dust emissions by the use of sealants, road washing, landscaping etc. Past measurements on company properties indicated that fugitive dust emissions were considerable. There have also been improvements in control of industrial point sources and apartment incinerators were banned in 1989. All of the above control efforts must be maintained and expanded to achieve further improvements. These may include measures to reduce dirt track out onto streets and increased planting of vegetation. Ground cover vegetation reduces blow off of dust, while trees reduce ground level wind speed and filter dust from the air. Continued efforts by both industry and the municipality will be necessary if objectives are to be attained in the lower city.

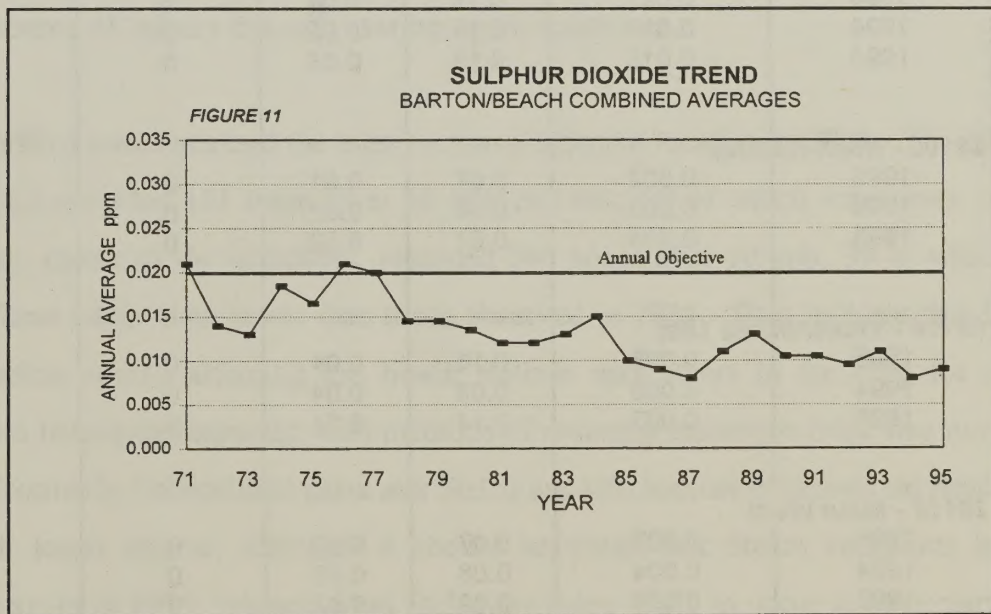
In 1995, charges were brought against two major companies for fugitive dust emissions that occurred in 1994.

The Air Quality Stakeholder Committee has identified fugitive dust related to transportation and road cleaning as a major opportunity for improvement.

4.4 Sulphur Dioxide

Most sulphur dioxide (SO₂) emissions in Hamilton stem from industrial sources. A smaller portion is accounted for by fuel burning in domestic space heating. Data for seven stations are summarized in Table 6, which lists objectives based on vegetation damage (hourly and yearly) and health effects (daily).

Sulphur dioxide trends from the two oldest stations are illustrated in Figure 11. Stable levels are evident in recent years. In 1995, as in the past several years, the concentrations were acceptable based on the yearly, daily and hourly objectives. All readings at all four AQI stations fell in the Very Good range of the AQI.



Sulphur dioxide generally shows a gradient with distance from the industrial zone, with the highest average (.011 ppm) measured at the Beach site (downwind of prevailing winds), while lowest levels were recorded at the east end (.002) and west end (.003).

TABLE 6
SULPHUR DIOXIDE

parts per million

YEAR		ANNUAL AVERAGE	MAXIMUM		No. Times Over Objective	
			1 hr	24 hr	1 hr	24 hr
29000 - Elgin/Kelly						
1995		0.008	0.08	0.03	0	0
1994		0.005	0.09	0.03	0	0
1993		0.006	0.10	0.03	0	0
29025 - Barton/Sanford						
1995		0.007	0.11	0.05	0	0
1994		0.006	0.13	0.04	0	0
1993		0.009	0.11	0.04	0	0
29102 - Beach Blvd						
1995		0.011	0.14	0.04	0	0
1994		0.010	0.16	0.05	0	0
1993		0.013	0.15	0.05	0	0
29105 - Nash/Kentley						
1995		0.002	0.07	0.01	0	0
1994		0.003	0.06	0.02	0	0
1993		0.004	0.07	0.02	0	0
29114 - Vickers/East 18th						
1995		0.005	0.16	0.04	0	0
1994		0.006	0.08	0.04	0	0
1993		0.007	0.14	0.04	0	0
29118 - Main West						
1995		0.003	0.07	0.02	0	0
1994		0.004	0.08	0.03	0	0
1993		0.005	0.09	0.02	0	0
29561 - Vansitmart Ave.						
1995*		0.009	0.10	0.04	0	0
1994+		0.006	0.09	0.02	0	0

Ontario Objectives: .25 ppm (1 hour)
.10 ppm (24 hour)
.02 ppm (annual average)

* Terminated in Sep 95 + Started in July 94

4.5 Total Reduced Sulphur

These gases are comprised of hydrogen sulphide (H_2S), the "rotten egg" gas and other sulphur compounds and the mixture is referred to as total reduced sulphur (TRS). There are no general objectives for TRS. However, an hourly objective for H_2S of 20 ppb may be compared to the observed values since most emissions are thought to consist mainly of H_2S . The data from seven stations given in Table 7 are also compared to the 10 ppb level - an approximate odour threshold for H_2S .

The major sources of hydrogen sulphide and related sulphur compounds are the steel industry's coke ovens and related by-products operations, slag quenching processes, a tar plant and, under upset conditions, a local manufacturer of carbon black. The sewage treatment plant is another potential source of odours but only during upset conditions.

The Beach Blvd area remained the most seriously affected location by TRS. The 29102 - Beach Blvd. station recorded 131 hours over 10 ppb in 1994, 29 of which were over 20 ppb. The Pier 25 site, closer to the industries, recorded 246 hours over 10 ppb, 39 of which were over 20 ppb. These totals were fewer than those observed in 1994. Data indicate that Dofasco Inc. was the prime source affecting the Beach stations and others in the City for many years. Dofasco has been experimenting with methods of reducing emissions from slag quenching. The Ruetgers (formerly Carbochem) plant and Stelco are also sources of impact on Beach Blvd., but to a much lesser degree, although it should be noted that Stelco emissions have become prominent again in 1996. Impacts from Stelco are more likely to occur at other parts of the city during winds from the northeast.

The Barton station measured 54 hours above 10 ppb in 1995; the Mountain station measured 18 such hours (all in the moderate range of the AQI); the Elgin/Kelly station downtown measured 25 hours over 10 ppb, 2 of which were in the Poor range of the AQI; Main West recorded 12 hours over 10 ppb, 3 of which were in the Poor range of the AQI, while the east end site measured two hours over 10 ppb, one of which were in the Poor range of the AQI. The Vansitmart station recorded 11 hours over 10 ppb, 3 of which were over 20 ppb.

TABLE 7
TOTAL REDUCED SULPHUR

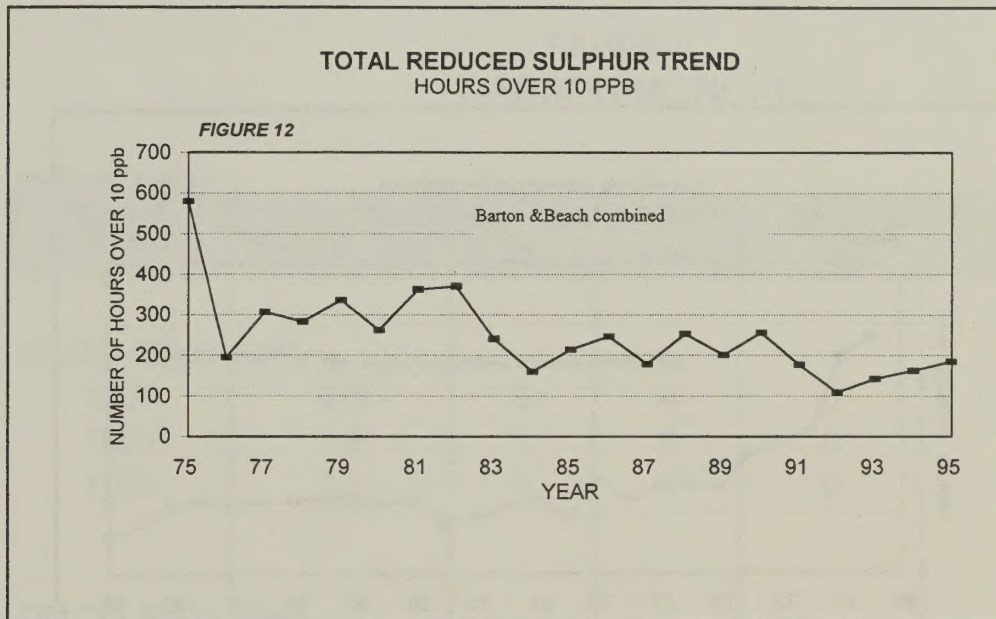
parts per billion

YEAR	ANNUAL AVERAGE	MAXIMUM 1 hr	No. Hours Over	
			10 ppb	20 ppb
29000 - Elgin/Kelly				
1995	1.2	48	25	2
1994	1.1	47	41	8
1993	0.7	13	13	0
29025 - Barton/Sanford				
1995	1.2	53	54	13
1994	1.2	19	41	0
1993	1.4	26	42	3
29102 - Beach Blvd				
1995	1.6	65	131	29
1994	1.5	51	122	34
1993	1.5	31	100	14
29105 - Nash/Kentley				
1995	0.6	31	2	1
1994	1.0	11	1	0
1993	0.6	10	0	0
29114 - Vickers/East 18th				
1995	0.6	19	18	0
1994	0.7	26	9	1
1993	0.8	36	17	2
29118 - Main West				
1995	0.9	30	12	3
1994	0.7	16	10	0
1993	0.6	16	12	0
29547 - Pier 25				
1995	2.4	113	246	39
1994	2.7	355	277	78
1993	2.1	44	166	24
29561 - Vansitmart/Strathearne				
1995	1.2*	53	11	3
1994	1.4+	118	12	6

Ontario Objectives: 20 ppb (1 hour - Hydrogen sulphide)

* Terminated in Sep 95 + Started in July 94

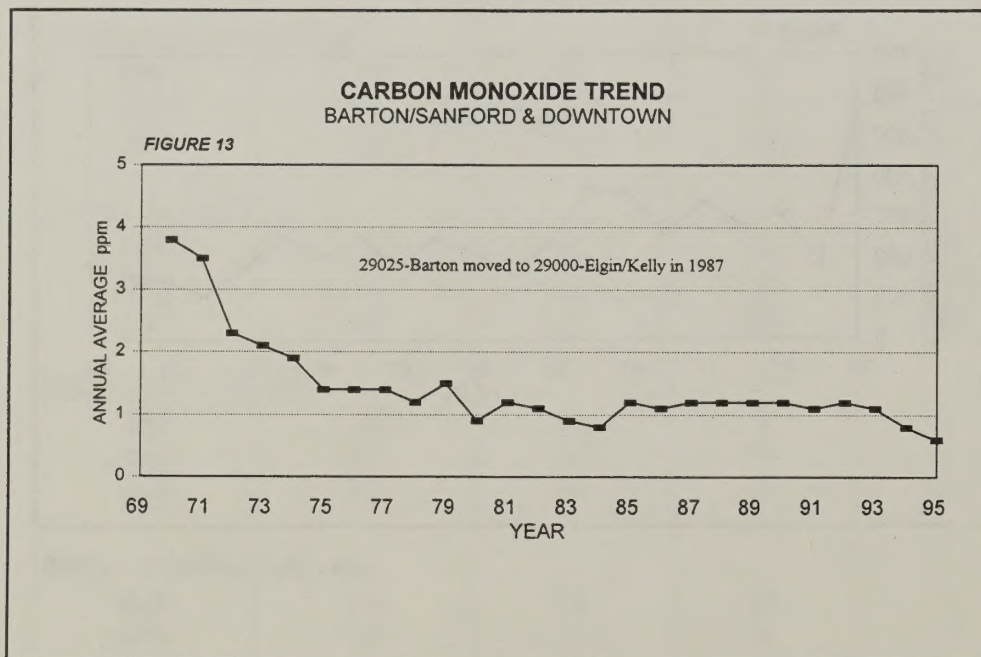
Figure 12 displays the trend of 10 ppb exceedences per year at the Beach and Barton stations the two oldest sites. An overall decline is apparent, most of which relates to the Barton location. However, levels have been gradually rising since 1992. The Beach Blvd area and other areas in the industrial zone still experience numerous odorous concentrations of these contaminants.



Dofasco submitted a proposal to study TRS emissions as a result of long standing Ministry data that indicated they were the major source of TRS at Beach Blvd. The plan called for source identification and recommendations for remediation. There was inadequate technology to allow the company to complete source sampling and analysis. Odour masking trials with peroxide were unsuccessful. In light of this, emphasis refocussed on improvements at other sources of sulphur to effect long term reductions.

4.6 Carbon Monoxide

The major source of carbon monoxide is the automobile although there are also some contributions from industry. Due to the requirements for automotive emission controls through the years, the levels measured at Barton Street (moved to Elgin/Kelly in 1987) have decreased greatly since the 1970's (Figure 13).



In 1995 the levels reduced further from the previous few years and were well below the objectives which are based on health effects (Table 8). Main West recorded similar levels to downtown. All AQI readings (both 1-hour and 8-hour) fell in the Very Good range.

**TABLE 8
CARBON MONOXIDE**

parts per million

parts per million					
YEAR	ANNUAL AVERAGE	MAXIMUM		No. Times Over Objective	
		1 hr	8 hr	1 hr	8 hr
29000 - Elgin/Kelly					
1995	0.6	6	4	0	0
1994	0.8	7	3	0	0
1993	1.1	6	4	0	0
29118 - Main West					
1995	0.6	7	6	0	0
1994	0.7	6	3	0	0
1993	0.8	5	4	0	0

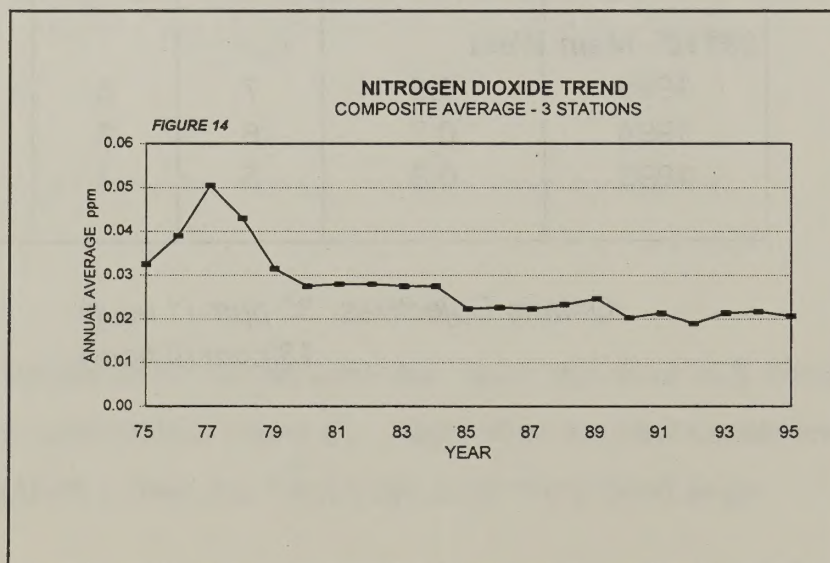
Ontario Objectives: 30 ppm (1 hour)
13 ppm (8 hour)

4.7 Nitrogen Dioxide

The primary sources of oxides of nitrogen are high temperature combustion sources including the automobile. The most abundant oxides are nitric oxide (NO) and nitrogen dioxide (NO₂). Nitric oxide is a direct emission which is then oxidized in the atmosphere to form nitrogen dioxide. Both pollutants were monitored continuously at four stations. At each station, a single instrument makes measurements of NO, NO₂ and total nitrogen oxide. Nitric oxide is measured directly, and the total oxides are measured by internally converting all other nitrogen oxides to nitric oxide. The instrument then determines nitrogen dioxide to be the difference between the first two measurements.

Objectives exist only for nitrogen dioxide and these are based on odour threshold levels (hourly) and health effects (24-hourly). Other adverse effects occurring at much higher levels include vegetation damage, reduced visibility, corrosion of metals and eventually, health effects. The objectives were not exceeded in 1995, similar to previous years.

Data for nitrogen dioxide are given in Table 9 and a combined yearly trend is illustrated in Figure 14. A slight downward trend is evident since 1980. Concentrations were highest on Beach Blvd. and lowest on the mountain.



These gases can transform by chemical reactions in the atmosphere into fine nitrate particles which can have human health implications as well as contribute to acid rain. Oxides of nitrogen are also an important factor in the photochemical cycle of ozone in the atmosphere. This will be discussed in the next section of this report.

TABLE 9
NITROGEN DIOXIDE

parts per million

YEAR	ANNUAL AVERAGE	MAXIMUM		No. Times Over Objective	
		1 hr	24 hr	1 hr	24 hr
29000 - Elgin/Kelly					
1995	0.019	0.08	0.05	0	0
1994	0.022	0.12	0.06	0	0
1993	0.022	0.10	0.06	0	0
29102 - Beach Blvd					
1995	0.024	0.09	0.06	0	0
1994	0.023	0.09	0.06	0	0
1993	0.023	0.09	0.07	0	0
29114 - Vickers/East 18th					
1995	0.015	0.07	0.04	0	0
1994	0.018	0.09	0.05	0	0
1993	0.018	0.10	0.06	0	0
29118 - Main West					
1995	0.019	0.09	0.05	0	0
1994	0.020	0.13	0.07	0	0
1993	0.019	0.12	0.07	0	0

Ontario Objectives: .20 ppm (1 hour)
.10 ppm (24 hour)

4.8 Ozone

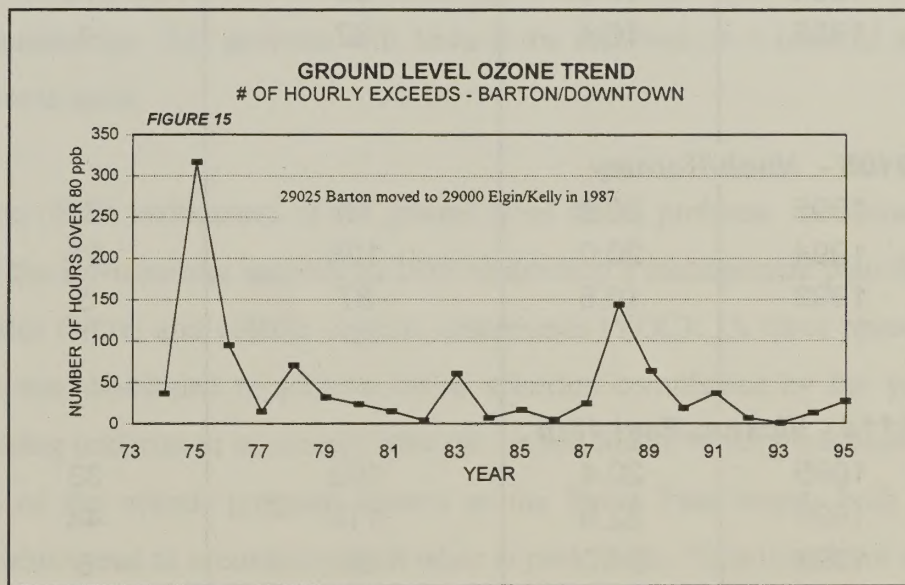
Oxidants are produced by photochemical reactions involving oxides of nitrogen, hydrocarbons and sunlight. Ozone accounts for most of the oxidants produced. The sources of the precursor pollutants are mainly industrial and automotive. The rate of oxidant production is dependent on the quantity of precursor pollutants, temperature and intensity of sunlight.

This report deals only with Ontario measurements of ground level ozone. However, regulations have also been passed by the Ministry to control the use and disposal of CFCs (chlorofluorocarbons) which destroy upper level ozone.

At high altitudes, ozone (the "ozone layer") filters harmful ultra violet radiation from incoming sunlight, but at the earth's surface, it is an unwelcome pollutant where it is known to cause respiratory problems to humans and is also injurious to different types of vegetation including certain tobacco, bean and tomato crops. The one-hour objective for ozone (80 ppb) is based on such vegetation effects, however, jogging or other strenuous exercise outdoors is not advisable for sensitive people above such levels. Exercise increases breathing rates and thus increases the amount inhaled.

Ground level ozone concentrations follow very definite annual and daily trends. Highest levels occur during the summer (May - September), and the daily maxima usually occur during late afternoon. Both patterns are directly related to temperature and the amount and intensity of sunlight.

Ozone was measured at the four Air Quality Index stations. Data are summarized in Table 10 while yearly trends are illustrated in Figure 15. The trend from year to year is unstable, being largely dependent on the climate of the summer. As mentioned in the Air Quality Index section, the AQI's ozone subindex scale was adjusted in 1995 to reflect new scientific information which indicated human health effects due to ozone occurred at levels lower than previously thought. The concentration required to reach the Moderate range reduced to 50 ppb from 80, and the Poor threshold reduced to 80 ppb from 120. This resulted in a significantly increased number of hours in the Moderate and Poor ranges. Ozone dominated the AQI during the summer, recording 400-500 hours in the Moderate or Poor ranges.



Although the AQI scale was adjusted, the hourly objective of 80 ppb remains unchanged, as it is protective of the majority of citizens. In 1995, the hourly objective was exceeded in a range from 27 to 34 hours at the four stations, more than the previous three years. This can be accounted for by the fact that the summer of 1995 was extremely hot and sunny, conducive to ozone formation. A hopeful sign is that the summer of '95 was similar weather-wise to 1988 when a large peak of ozone exceedances occurred. That peak did not reoccur to the same degree and may indicate the success of some long term control programs, given below.

During each elevated ozone episode, winds were southwest and warm temperatures prevailed. The origin of most of the ozone is believed to be the United States. This is confirmed by

TABLE 10
OZONE

parts per billion

YEAR	ANNUAL AVERAGE	MAXIMUM 1 hr	No. Times Over 1 hr Objective
29000 - Elgin/Kelly			
1995	18.0	98	27
1994	17.0	96	13
1993	16.4	82	1
29105 - Nash/Kentley			
1995	20.2	99	37
1994	20.0	126	21
1993	18.8	87	5
29114 - Vickers/East 18th			
1995	20.4	102	33
1994	22.9	119	44
1993	21.0	95	8
29118 - Main West			
1995	18.1	100	34
1994	19.1	103	14
1993	16.7	78	0

Ontario Objectives: 80 ppb(1 hour)

stations close to the shore of Lake Erie. One such station at Long Point, upwind of all Canadian sources, measured 128 hours above the objective in 1995, the most in the Province. Canadian sources, including vehicles do contribute to the problem however.

Ozone, hydrocarbons and oxides of nitrogen can be transported over great distances and can be augmented by local sources. Paradoxically, Hamilton and other major urban areas usually experience lower ozone concentrations than their more rural surroundings during peak occurrences. This is due to the numerous high temperature combustion sources in cities which produce scavengers of ozone such as nitric oxide. Nonetheless, ozone and other oxidants remain a problem in the Hamilton area. Due to the complexity of oxidant formation and the long range transport phenomenon, this problem will have to be resolved on a national and international rather than local scale.

In recognition of the seriousness of the ground level ozone problem, the Canadian Council of Ministers of the Environment decided in 1988 to develop a management plan for the control of nitrogen oxides (NO_x) and volatile organic compounds (VOC). A three phase No_x and VOC control plan was developed to achieve ozone criterion compliance by the year 2005. This program is being undertaken in concert with the United States which plans similar strategies. A continuation of the overall program known as the Smog Plan targets both ozone and fine particulates which tend to accompany each other at peak times. Timelines have set the year 2015 to achieve certain goals for reductions of these pollutants.

The Ministry is taking initiatives in combatting photochemical smog. To reduce NO_x and VOC, the precursors of ozone, a number of new regulations are being introduced including:

- The requirement for gasoline companies and service stations to install vapour recovery equipment on fuel tanks and trucks (by 1996).
- NO_x emissions from stationary turbines must be reduced from 200 ppm to 25 ppm.
- Refineries must produce gasolines which are less volatile during the summer.
- Dry cleaners will be required to undergo education programs to minimise their VOC emissions.
- Ontario Hydro has already reduced their NO_x emissions by 37 kilotonnes in the past 2 years.

Further, as an interim measure, the Ministry, in co-operation with Environment Canada, broadcasts air quality advisories for Southern Ontario related to the ozone monitoring program.

When ozone levels are expected to reach 80 ppb or higher the next day, such a forecast will be included in normal weather reports. The public is advised to avoid strenuous exercise, and that sensitive individuals may experience respiratory symptoms and should alter their activities accordingly. The public is encouraged to reduce their use of automobiles, to car pool, to use public transit and to avoid the use of oil based paints and solvents and gasoline powered equipment such as lawn mowers.

4.9 Fluoridation

This measurement is a relatively simple assessment used to determine quantities of various fluoride compounds in the ambient air. A lime coated paper is exposed to the atmosphere for one month and is then chemically analyzed for fluoride. The fluoride objectives are based on vegetation damage and for this reason, the objective is more stringent during the growing season. For the period of April to October the objective is 40 micrograms/100 square centimetres/ 30 days while for the remainder of the year it is 80.

In Hamilton, the major fluoride sources are the basic oxygen furnaces used by the major steel industries which require fluorspar as a fluxing agent and a brick manufacturing plant at the base of the escarpment near Gage Park. In addition to these process emissions, there are other minor sources such as coal burning, since coal contains trace amounts of fluoride.

Data are summarized in Table 11 and the yearly trend since 1970 is illustrated in Figure 16.

The trend graph shows that levels have declined steadily to the point that the monthly objectives were only occasionally marginally exceeded. The trend graph does not include data from the Hamilton Brick plant to be discussed below.

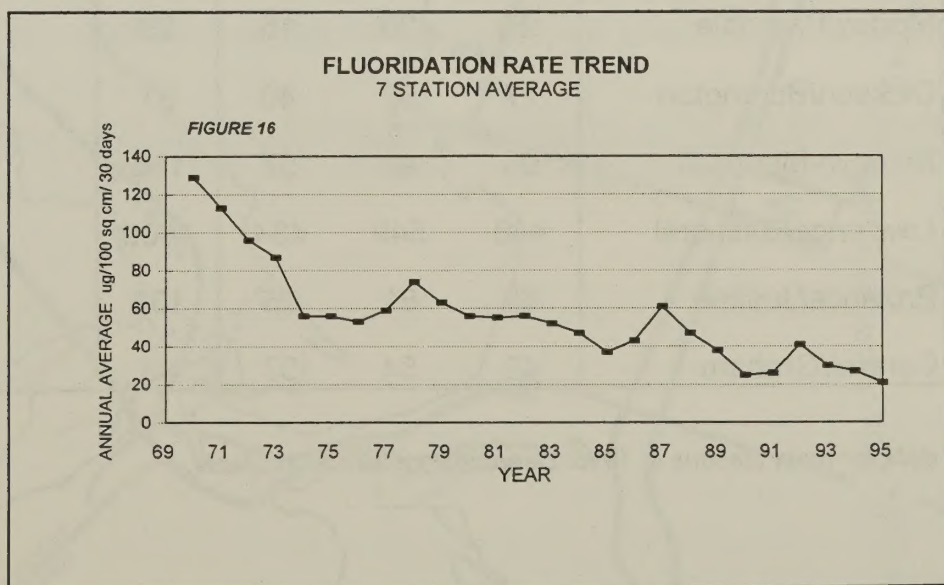


TABLE 11
FLUORIDATION RATE

Ontario Objectives: 40 ug/100 sq cm/30 days (April - October)
80 ug/100 sq cm/30 days (November - March)

micrograms per 100 square centimetres per 30 days

STATION NUMBER	LOCATION	AVERAGE			MAX	No. of Months Over Objective (1995)
		1993	1994	1995	1995	
29001	Hughson/Hunter	30	17	17	32	0
29012	Burlington/Wellington	16	15	14	24	0
29025	Barton/Sanford	33	21	18	33	0
29054	Beach/Conrad	28	23	17	38	0
29059	Burlington/Gage	43	37	27	37	0
29062	King E/Cochrane	42	45	36	60	3
29066	Killarney/Beach Blvd	29	28	19	26	0
29115	London/Justine	98	146	96	299	8
29116	Dalkeith/Ottawa	38	21	19	31	0
29119	Morley/Parkdale	26	20	15	23	0
29120	Dickson/Burlington	77	62	40	61	5
29126	Rosslyn/Montclair	95	93	57	135	4
29127	Lawrence/Balmoral	448	549	434	1000	9
29129	Province/Justine	65	81	65	134	6
29131	Central/Graham	42	54	37	88	4

11 Months of data for most stations in 1995. December results unavailable.

$\mu\text{g}/100 \text{ sq. cm}/30 \text{ days}$ 

A contour plot of yearly averages is given in Figure 17. A small ring can be drawn near the industrial area as shown. The worst station within this area recorded five samples above the monthly objectives in 1995, but no other station measured any exceedances at all (except for the Hamilton Brick sites).

The most prominent individual source of airborne fluoride in the city is the Hamilton Brick Co., near Gage Park. A network of five monitors recorded high levels well above objectives again in 1995.

Elevated fluoride concentrations near brick plants are common. A 1983 report undertaken jointly by the Ontario Ministries of Environment, Health and Labour concluded that " the maximum additional intake of fluoride resulting from exposure to brick plant fluoride emissions is small. It is concluded that this additional intake could be considered to fall within the normal range of fluoride intake from dietary sources and as such would not be expected to induce health effects in an exposed population" (p.24). This report was based on measurements near a Toronto and a Brampton brick plant. Concentrations in Toronto and Brampton were comparable to those measured at the Hamilton stations.

Although human health concerns are not a problem, light to severe injury to sensitive vegetation (mostly silver maple) has been observed in the vicinity of the plant in 1986, 1987 and 1991 surveys. Injury and fluoride concentrations in the vegetation decreased with distance from the brick plant. There have been no public complaints regarding vegetation damage in the vicinity of Hamilton Brick.

Hamilton Brick Co. has upgraded their drying ovens and reduced the temperatures used in the process in conjunction with the installation of more efficient kilns. The Ministry has conditionally approved a control technology to reduce emissions from this plant.

4.10 Hydrocarbons - Volatile Organic Compounds (VOC)

Airborne organic chemicals are of concern due to their complexity and variety of potential toxic effects, including carcinogenicity. The monitoring methodology of volatile organics involves drawing a measured volume of air through a glass cartridge containing an adsorbent material. Samples are run for 24 hours (midnight to midnight) every 12th day. The cartridge is then desorbed and analyzed by gas chromatography at the laboratory. The Ministry monitors 32 different organic compounds in this way. A total of 20 of these compounds have 24 hour guidelines and half hour standards.

Data from 1995 for five stations are given in Tables 12a and 12b. The data are summarized by the number of samples a contaminant was detected, the averages for the past 4 years (calculated if at least 20% of samples showed detectable levels), and the maximum value measured in 1995.

It can be seen that all stations met all of the 24-hour guidelines and that concentrations show varying trends over the four years of monitoring. Some parameters were lower than in 1992, others were similar or higher. Highest levels were observed at the industrial zone station 29113, particularly during inversion conditions. Lowest levels were measured at Pier 25 and the mountain (except for benzene and naphthalene).

The data show that with the exception of benzene and naphthalene, vehicle traffic appears to be the major contributor to these readings. As mentioned, Pier 25, despite its proximity to the industrial area, and being downwind of prevailing winds, generally recorded the lowest averages of these pollutants. The roadways near the Pier site may have less influence than at other stations because the main road near the station is the QEW - a major highway rather than a city street. Vehicle emissions at higher speeds tend to be less than from low speed traffic. Figure 18 visually depicts the spatial variation of most of the VOCs using toluene as an indicator. While the industrial zone station 29113 shows the largest average in this figure, this average was skewed by one particularly elevated result on November 17, a day combining calm southwest winds and an inversion. Traffic rather than industry is suspected to have been the primary source.

TABLE 12a
VOLATILE ORGANICS (VOC) - 1995

micrograms per cubic metre				29000 - Elgin/Kelly				29113 - Gertrude/Depew				29547 - Pier 25			
24 HR GUIDELINE	No of Detects	Average			Max 1995	No of Detects	Average			Max 1995	No of Detects	Average			Max 1995
		1995	1994	1993	1992		1995	1994	1993	1992		1995	1994	1993	1992
VINYL CHLORIDE	1	0				0					0				
1,3-BUTADIENE		11	0.1	0.1		5		0.1	0.1	0.1	3	0.1			0.2
ISOPRENE		23	0.2	0.2	0.2	24	0.5	0.2	0.1	0.2	15	0.1	0.1		0.3
1,1-DICHLOROETHENE	35	26	0.1	0.1	0.2	11	0.7	0.1	0.2	1.2	9	0.1		0.1	0.7
DICHLOROMETHANE	1765	26	1.8	2.7	0.9	25	15.1	1.5	0.5	1.4	27	3.2	1.0	0.4	47.2
1,1-DICHLOROETHANE		0				2				0.1	0				
HEXANE	12000	26	4.9	3.9	4.3	26	11.4	2.8	2.2	4.4	27	1.1	1.0	1.0	4.6
TRICHLOROMETHANE	500	16	0.1	0.1	0.1	18	0.1	0.1	0.9	0.3	14	0.1	0.1	1.9	0.2
1,2-DICHLOROETHANE	400	0			0.1	2				0.1	0				0.1
CYCLOHEXANE	100000	25	0.2	0.2	0.3	25	1.9	0.3	0.2	0.5	21	0.1	0.1	0.1	0.4
CARBON TETRACHLORIDE	600	26	0.4	0.4	0.4	25	0.6	0.4	0.4	1.6	27	0.5	0.4	0.5	3.2
BENZENE		26	2.9	2.2	3.0	26	8.1	6.3	3.7	7.3	27	5.1	4.0	4.2	13.8
TRICHLOROETHYLENE	28000	23	0.1	0.1		22	0.4	0.2	0.1	0.2	21	0.2	0.2	0.1	0.4
1,1,1-TRICHLOROETHANE	115000	26	1.3	1.6	3.1	25	2.8	1.4	2.2	4.8	27	0.7	0.7	1.1	2.5
1,2-DICHLOROPROPANE	2400	0				1					0				
TOLUENE	2000	26	4.8	5.1	5.9	26	8.7	7.4	6.6	7.1	27	3.3	2.7	2.9	13.0
1,1,2-TRICHLOROETHANE		0				0				0.4	0				
1,2-DIBROMOETHANE		0				0				0.5	0				
TETRACHLOROETHYLENE	4000	26	0.6	0.9	1.7	25	2.2	0.5	0.4	0.8	25	0.3	0.2	0.2	1.3
CHLOROBENZENE		0			3.7	1	0.1				1				0.1
ETHYLBENZENE	4000	26	0.8	0.9	0.9	26	1.1	1.4	1.2	1.6	27	0.5	0.6		2.4
M-XYLENE	2300	26	2.8	2.9	3.1	26	3.6	4.9	4.4	3.6	27	1.6	2.0	1.6	7.9
STYRENE	400	22	0.1	0.1	0.1	23	0.3	0.3	0.2	0.4	21	0.2	0.1		0.4
O-XYLENE	2300	26	0.8	1.0	1.0	26	1.1	1.7	1.4	1.7	27	0.5	0.7	0.5	2.2
1,1,2,2-TETRACHLOROETHANE		0			0.4	1				0.2	0				
a-PINENE		16	0.1	0.5		19	0.2	0.1		0.8	14	0.1	0.1		0.5
1,3,5-TRIMETHYLBENZENE		26	0.3	0.5	0.5	25	0.4	0.7	0.7	1.2	21	0.2	0.2	0.2	0.4
1,2,4-TRIMETHYLBENZENE	1000	26	0.9	1.7	1.4	25	1.1	2.1	1.8	2.9	26	0.4	0.7	0.5	1.1
1,3-DICHLOROBENZENE		0				0				0.4	0				
1,4-DICHLOROBENZENE		7	0.1	0.2	0.3	8	0.1	0.2	0.2	0.5	1	0.1	0.1	0.1	0.5
1,2-DICHLOROBENZENE	30500	0				1				0.2	0				
NAPHTHALENE	22.5	24	0.8	1.6		25	2.2	3.1	2.0	1.0	24	2.9	2.4		9.2

TABLE 12b
VOLATILE ORGANICS (VOC) - 1995

micrograms per cubic metre			29102-Beach Blvd					29114 - Vickers/East 18th				
24 HR GUIDELIN	No of Detects	Average			Max 1995	No of Detects	Average			Max 1995		
		1995	1994	1993			1995	1994	1993			
VINYL CHLORIDE	1	0				0						
1,3-BUTADIENE		5	0.1	0.1	0.1	7	0.1	0.1	0.1	0.3		
ISOPRENE		23	0.2	0.2	0.2	19	0.1	0.1	0.1	0.4		
1,1-DICHLOROETHENE	35	13	0.1	0.1	0.6	13	0.1	0.1	0.1	0.3		
DICHLOROMETHANE	1765	26	5.9	2.4	1.1	24	2.1	4.0	2.1	9.8		
1,1-DICHLOROETHANE		0		0.1		0						
HEXANE	12000	26	1.7	1.5	1.7	24	1.3	1.2	1.2	3.9		
TRICHLOROMETHANE	500	21	0.1	0.1	0.2	16	0.1	0.1	0.1	0.1		
1,2-DICHLOROETHANE	400	0			0.1	0						
CYCLOHEXANE	100000	25	0.2	0.2	0.2	23	0.1	0.1	0.1	0.4		
CARBON TETRACHLORIDE	600	26	0.8	0.5	2.1	24	0.5	0.4	0.4	0.7		
BENZENE		26	5.8	4.3	4.7	24	1.9	1.9	1.9	8.4		
TRICHLOROETHYLENE	28000	23	0.2	0.1	0.2	19	0.1	0.1		0.3		
1,1,1-TRICHLOROETHANE	115000	26	1.0	0.9	1.5	24	0.7	0.6	0.8	3.0		
1,2-DICHLOROPROPANE	2400	0				0						
TOLUENE	2000	26	4.4	3.5	4.1	24	3.2	3.0	3.1	8.4		
1,1,1,2-TRICHLOROETHANE		0				0						
1,2-DIBROMOETHANE		0				0						
TETRACHLOROETHYLENE	4000	26	0.5	0.2	0.5	23	0.4	0.3	0.4	3.4		
CHLOROBENZENE		0				0						
ETHYLBENZENE	4000	26	0.7	0.7	0.8	24	0.5	0.6	0.6	2.1		
M-XYLENE	2300	26	2.4	2.5	2.3	24	1.8	2.0	2.2	7.4		
STYRENE	400	22	0.2	0.2	0.3	9	0.1	0.1		0.4		
O-XYLENE	2300	26	0.8	0.8	0.8	24	0.5	0.7	0.7	1.7		
1,1,2,2-TETRACHLOROETHANE		0				1				0.1		
a-PINENE		15	0.1	0.2		16	0.4	0.2		1.4		
1,3,5-TRIMETHYLBENZENE		25	0.3	0.3	0.3	21	0.2	0.3	0.4	0.6		
1,2,4-TRIMETHYLBENZENE	1000	26	0.7	1.0	0.8	24	0.5	1.0	1.2	1.6		
1,3-DICHLOROBENZENE		0				0						
1,4-DICHLOROBENZENE		0		0.1	0.1	4		0.1	0.1	0.2		
1,2-DICHLOROBENZENE	30500	0				0						
APHETHALENE	22.5	24	2.6	3.3	3.1	19	0.9	1.2	1.4	6.4		

FIGURE 18

TOLUENE 1995

AVG(MAX)

UG/M3

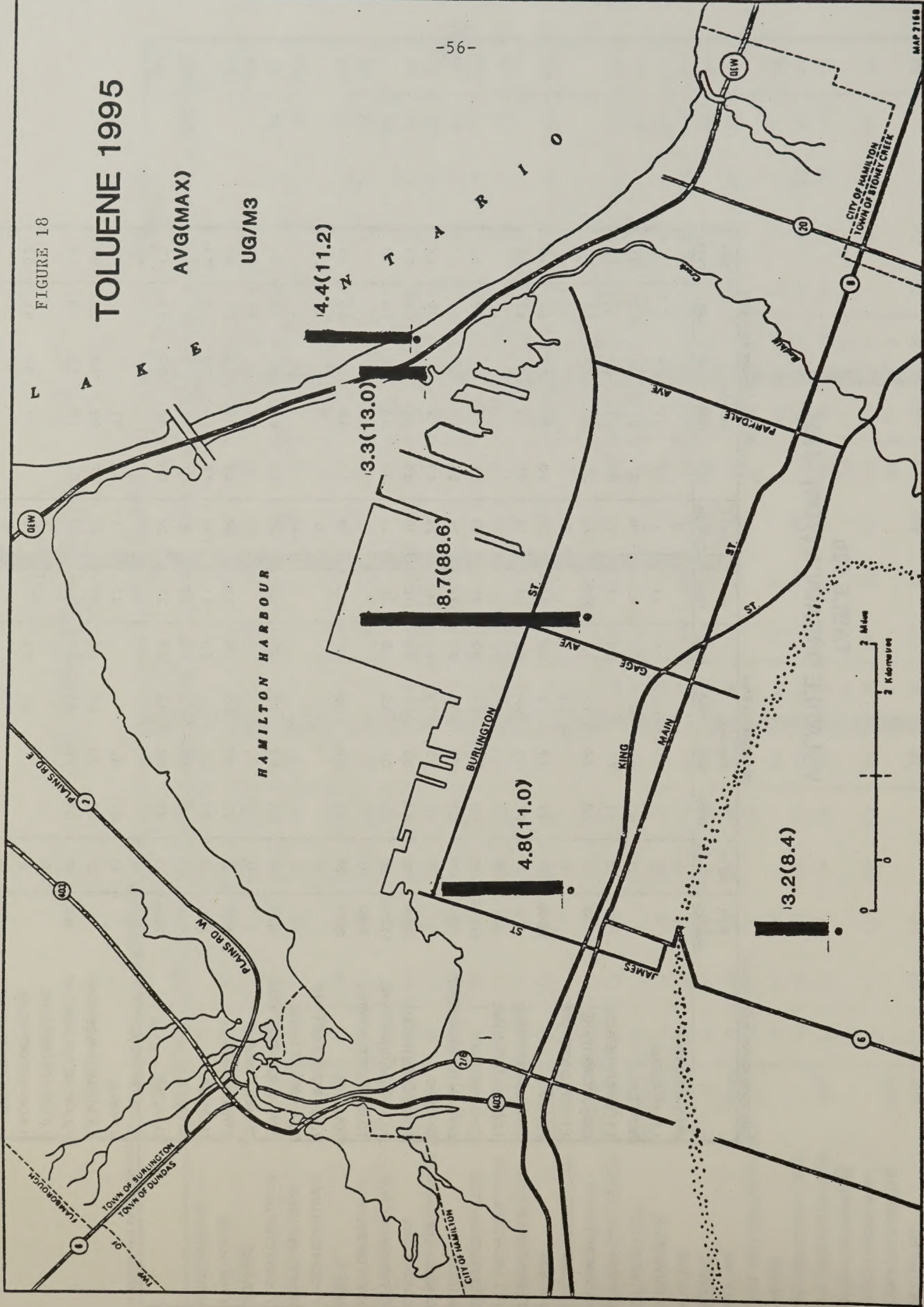
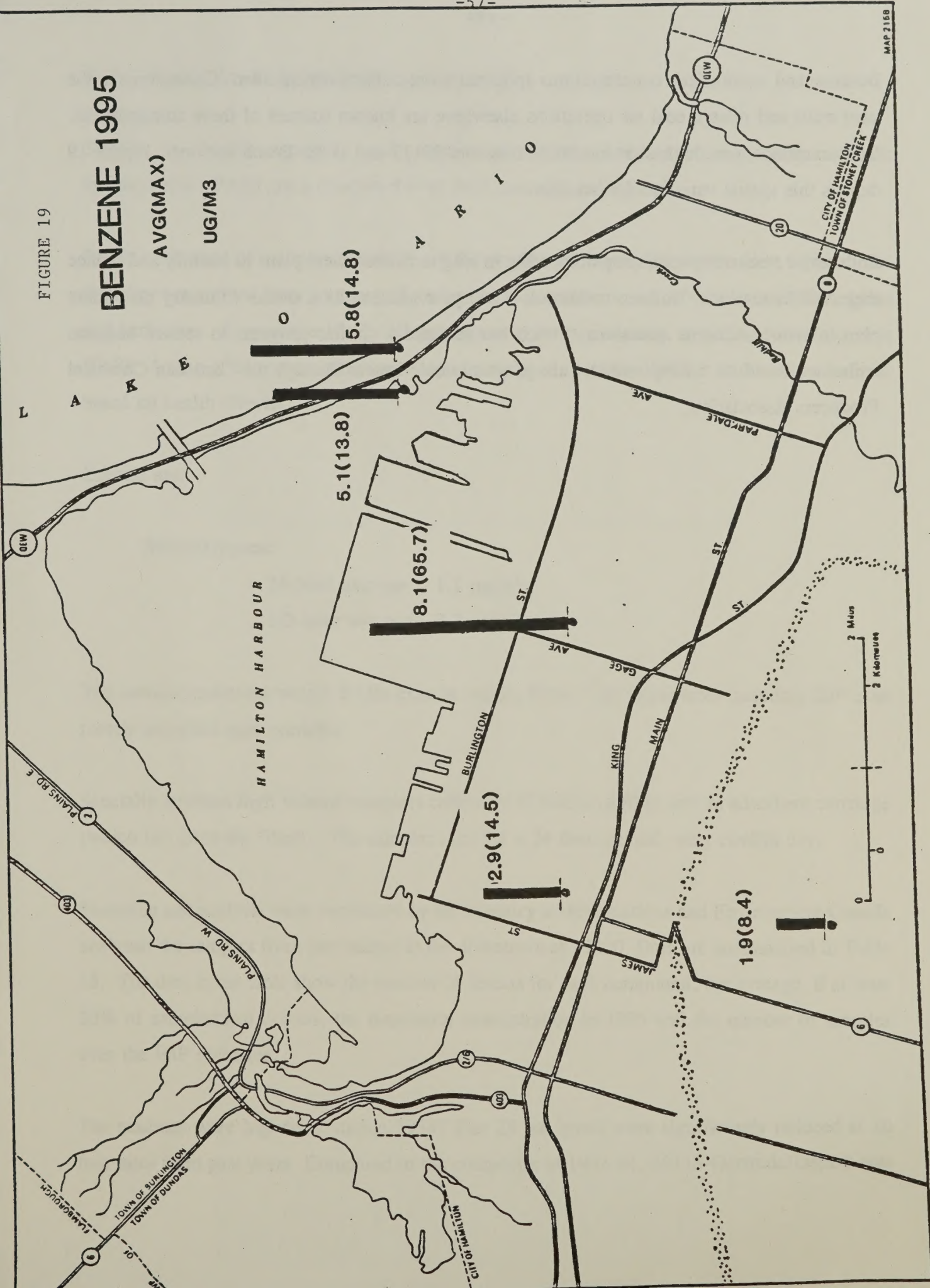


FIGURE 19

BENZENE 1995

AVG(MAX)

UG/M3



Benzene and naphthalene concentrations appeared more industrially oriented. Coke ovens at the steel mills and related coal tar operations elsewhere are known sources of these contaminants. Concentrations were highest at industrial zone site 29113 and at the Beach stations. Figure 19 depicts this spatial variation for benzene.

Both major steel companies are participating in long term abatement plans to identify and reduce their VOC emissions. Dofasco undertook a two year multi-million dollar voluntary abatement plan to reduce benzene emissions. Stelco has initiated a similar program to reduce benzene emissions based on a Responsible Care program commitment through the Canadian Chemical Producers Association.

4.11 Polycyclic Aromatic Hydrocarbons (PAH)

Similar to volatile organics, other semi-volatile compounds called polycyclic aromatic hydrocarbons (PAH) are a concern due to their potential toxic effects.

PAHs are a class of compounds which are the product of incomplete combustion of fuels, and thus they are emitted from a variety of sources including coke ovens, woodstoves, diesel engines and barbecues. Several specific PAHs are known to be carcinogenic, including benzo(a)pyrene (BaP). A scan of 24 compounds were routinely analyzed, but only BaP has standards/guidelines, based on health effects.

Criteria are:

Benzo(a)pyrene

24-hour average - 1.1 ng/m^3

1/2-hour average - 3.3 ng/m^3

The smaller molecular weight PAHs exist in vapour form. The larger ones including BaP exist mostly adsorbed onto particles.

Specially outfitted high volume samplers collect PAH both on a filter and an adsorbent cartridge (which lies after the filter). The sampler runs for a 24 hour period every twelfth day.

Sampling and analysis were conducted by the Ministry at three stations and Environment Canada analyzed the samples from one station in the downtown at 29000. Data are summarized in Table 13. The data in the table show the number of detects for each compound, the average, if at least 20% of samples had detects, the maximum concentration in 1995 and the number of samples over the BaP objective.

The readings were highest at station 29547-Pier 25 but levels were significantly reduced at all four sites from past years. Compared to the composite of 1992-94, 29113-Gertrude/Depew was

TABLE 13

POLYCYCLIC AROMATIC HYDROCARBONS (PAH) IN HAMILTON - 1995

nanograms per cubic metre

29113 - Gertrude/Depew		29547 - Pier 25						29114 - Vickers/East 18th						Analysis by Environment Canada 29000 - Elgin/Kelly											
24 Hour Objective	No of Detects	Average			Max	No. Times Over Obj.	No of Detects	Average			Max	No. Times Over Obj.	No of Detects	Average			Max	No. Times Over Obj.							
		1995	1994	1993				1995	1994	1993				1995	1994	1993			1995	1994	1993				
PAH TOTAL	27	148.0	330.6	219.6	515.5	474.2	28	187.4	284.6	280.9	345.4	503.9	28	77.1	107.5	98.4	133.9	284.0	23	68.9	108.2	110.1	187.4	271.9	
BIPHENYL	27	17.9	28.5	20.4	44	54.8	25	19.8	22.1	19.7	26.2	67.6	28	10.6	11.6	12.5	16.2	32.5		na	na	na	na		
ACENAPHTHYLENE	27	16.6	35.7	28.3	49.2	61.9	22	15.8	24.1	24.3	32.4	64.0	28	7.6	11.9	9	16.6	41.1		na	na	na	na		
ACENAPHTHENE	26	14.3	49.1	18	130	69.6	26	27.3	55.8	47.9	101	161.0	28	7.7	13.4	10.4	25.9	49.5		na	na	na	na		
FLUORENE	27	19.5	40.9	23.5	49.6	98.2	26	27.3	36.1	27.1	32.2	85.2	28	9.6	14.2	13.3	15.6	41.5		na	na	na	na		
PHENANTHRENE	23	29.3	83.9	52.7	129	154.0	17	27.7	64.1	55.6	56.1	134.0	25	16.9	28.2	27.2	26.3	48.2	23	22.9	44.8	45	60.3	86.0	
ANTHRACENE	26	1.6	15.9	7.9	13.1	7.1	24	3.4	6.8	9.7	9.9	14.8	25	0.7	1.8	1.8	3.4	3.4		na	na	na	na		
O-TERPHENYL	11	0.2	0.2	0.3	0.4	1.1	13	0.2				0.6	14	0.3				1.3		na	na	na	na		
1-METHYLPHENANTHRENE	27	2.9	3.5	2.8	5.9	11.0	26	3.7	3.1	2.9	3.8	9.7	28	1.3	1.2	1.2	1.9	4.8		na	na	na	na		
FLUORANTHENE	26	12.8	23.0	19.1	28.8	45.5	20	13.5	22.5	21.4	31.7	56.9	28	7.3	8.0	8.1	8.8	36.6	23	8.7	14.4	11.4	19.0	30.2	
PYRENE	27	9.6	16.5	15.1	19.8	28.8	23	12.4	15.9	19.3	21.5	42.2	28	4.7	5.5	6.5	6.1	25.6	23	6.6	10.1	7.6	13.4	33.9	
M-TERPHENYL	27	0.2	0.2	0.2		0.4	26	0.2	0.2	0.1		0.4	26	0.1	0.1	0.1		0.3		na	na	na	na		
P-TERPHENYL	0	0.1					0						0							na	na	na	na		
BENZO(A)FLUORENE	25	1.4	2.1	1.6	4.3	7.8	26	2.5	1.9	2.1	2.3	8.7	27	0.6	0.6	0.6	1.6	3.5		na	na	na	na		
BENZO(B)FLUORENE	24	1.6	2.0	1.3	3.1	9.5	23	2.8	1.9	1.6	1.8	10.4	20	0.7	0.6	0.4	1.0	4.3		na	na	na	na		
BENZO(A)ANTHRACENE	26	2.3	4.1	3.1	6	13.2	26	4.2	3.7	3.9	2.9	16.4	27	1.0	1.2	0.8	1.5	5.6		na	na	na	na		
CHRYSENE	27	3.5	5.7	4.6	6.1	16.6	26	6.4	6.2	5.6	3.8	18.0	27	1.7	2.0	1.5	1.9	9.9	23	1.8	3.1	2.3	3.5	9.7	
BENZO(B)FLUORANTHENE	27	4.4	4.0	3.3	10.5	22.4	26	6.9	4.2	3.7	4.4	23.6	27	2.2	1.5	1.1	2.6	11.2	23	2.4	4.8	3.0	3.9	16.0	
BENZO(K)FLUORANTHENE	25	1.4	2.4	2.4		6.5	23	2.3	2.5	3		7.8	24	0.8	0.9	0.8		3.7	23	*	*	*	*	*	
BENZO(E)PYRENE	23	1.2	3.5	2.9	3.4	4.7	22	2.0	3.7	3.5	1.9	8.6	22	0.5	1.3	1	1.1	2.0		na	na	na	na		
BENZO(A)PYRENE	24	0.9	3.0	2.2	3.1	3.0	26	1.8	2.7	2.8	1.9	8.3	25	0.4	0.8	0.5	0.8	1.9	2	0.8	1.6	1.1	1.3	4.7	
PERYLENE	8	0.2	0.6	0.4	0.8	1.2	14	0.5	0.6	0.6	0.5	1.9	5	0.2	0.1			0.5		na	na	na	na		
INDENO(123CD)PYRENE	27	2.3	4.1	2.7	3.9	10.2	26	3.5	3.4	3.3	1.9	11.0	28	1.1	1.6	0.8	1.3	5.1	23	1.0	1.9	1.3	1.9	4.9	
DIBENZO(A,H)ANTHRACENE	22	0.5				2.9	22	0.8				2.7	23	0.2				1.2		23	0.2	0.5	0.3	0.2	1.5
BENZO(GH)PERYLENE	26	2.1	2.5	1.9	3.7	8.8	26	2.6	2.4	2.2	2.6	8.5	26	1.0	0.9	0.7	1.2	5.2	23	1.2	2.3	1.2	2.3	5.8	

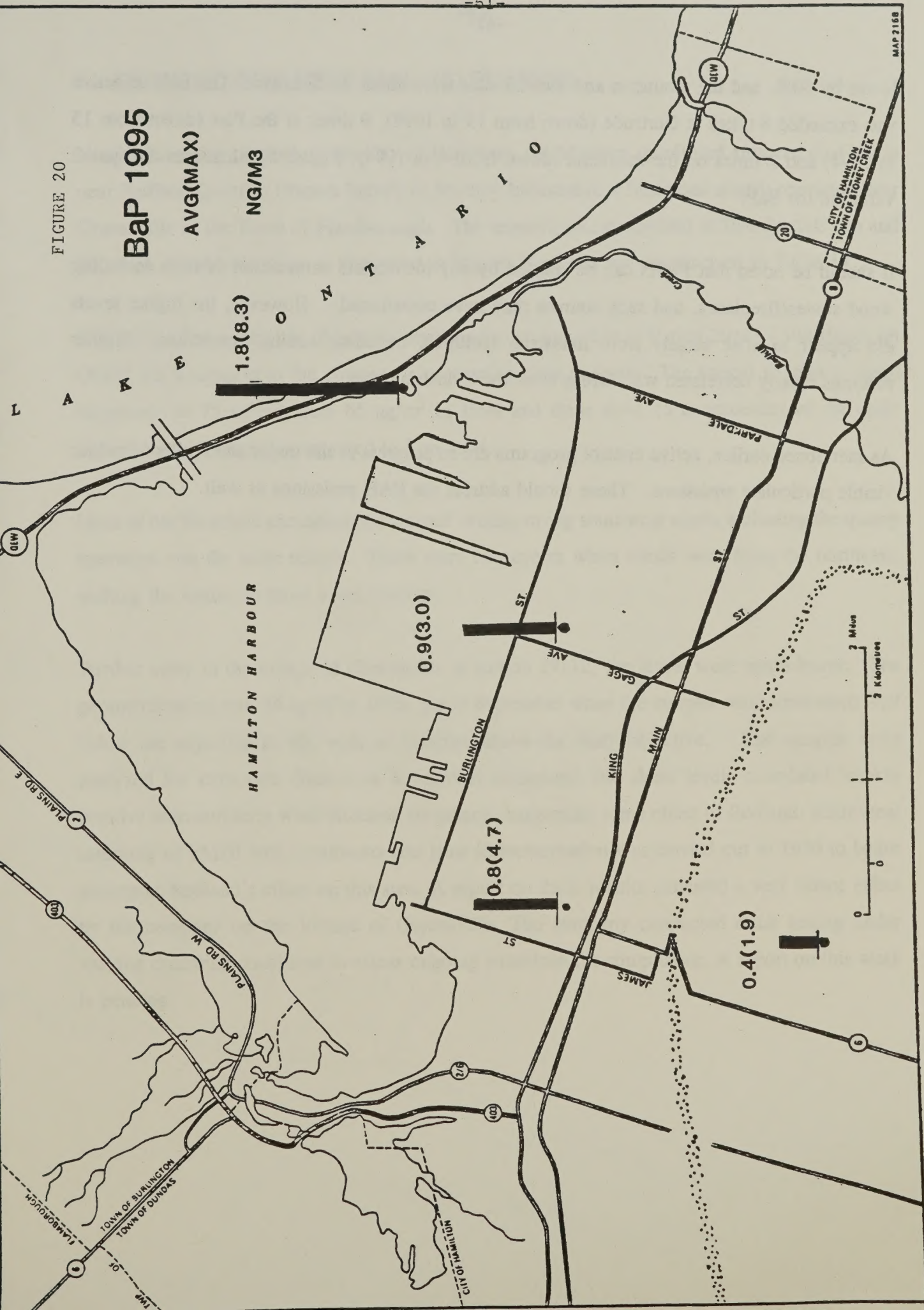
Objectives: BaP 1.1 (24 hr)
3.3 (1/2 hr)* reported together with benzo(b)fluoranthene
na - not analyzed
PAH Total not comparable to MOEE totals

FIGURE 20

BaP 1995

AVG(MAX)

NG/M3



lower by 60%, and the mountain and Pier 25 sites were about 35 % lower. The BaP objective was exceeded 8 times at Gertrude (down from 19 in 1994), 9 times at the Pier (down from 15 in 1994) and 2 times on the mountain (down from 6 in 1994). Figure 20 illustrates the spatial variation for BaP.

It should be noted that PAHs can be emitted by any incomplete combustion of fuels including wood stoves/fireplaces, and such sources may have contributed. However, the higher levels did appear to arise largely from industrial facilities, including coking operations. Higher readings clearly correlated with winds from the industrial zone.

As mentioned earlier, active control programs are in progress at the major steel mills to reduce visible particulate emissions. These should address the PAH emissions as well.

5. AIR MONITORING NEAR REDLAND QUARRIES

In addition to the network in the City of Hamilton, the Ministry monitored airborne dust levels near Redland Quarries (former known as Steetley Industries), a limestone quarry operation near Greensville in the Town of Flamborough. The network was comprised of five dustfall jars and two high volume samplers as illustrated in Figure 21. Data are summarized in Table 14.

The suspended particulate objectives continued to be exceeded at station 29111 - Westfield, on Ofield Rd S adjacent to the company's processing plant property. The annual geometric mean increased to 75 ug/m³ from 65 ug/m³ in 1994 and there were 15 exceedences of the daily objective of 120 ug/m³ compared to 5 in 1994.

Most of the Westfield exceedences occurred during strong southwest winds indicating the quarry operation was the main source. There were two events when winds were from the northeast, making the source in those cases unclear.

Further away in the village of Greensville at station 29112, the levels were much lower. The geometric mean was 34 ug/m³ in 1995, (up to September when the sampler was terminated) well below the objective of 60, with no samples above the daily objective. The samples were analyzed for carbonate (limestone is calcium carbonate) and these levels correlated weakly positive with northerly wind direction frequency, suggesting some effect of Redland. Additional sampling of PM₁₀ with continuous real time instrumentation was carried out in 1996 to better determine Redland's effect on this area. A report on those results indicated a very minor effect by the company on the Village of Greensville. The company conducted stack testing under varying operating conditions to assess ongoing emissions for compliance. A report on this work is pending.

FIGURE 21
MAP OF SAMPLING STATION LOCATIONS
NEAR REDLAND QUARRIES
FLAMBOROUGH

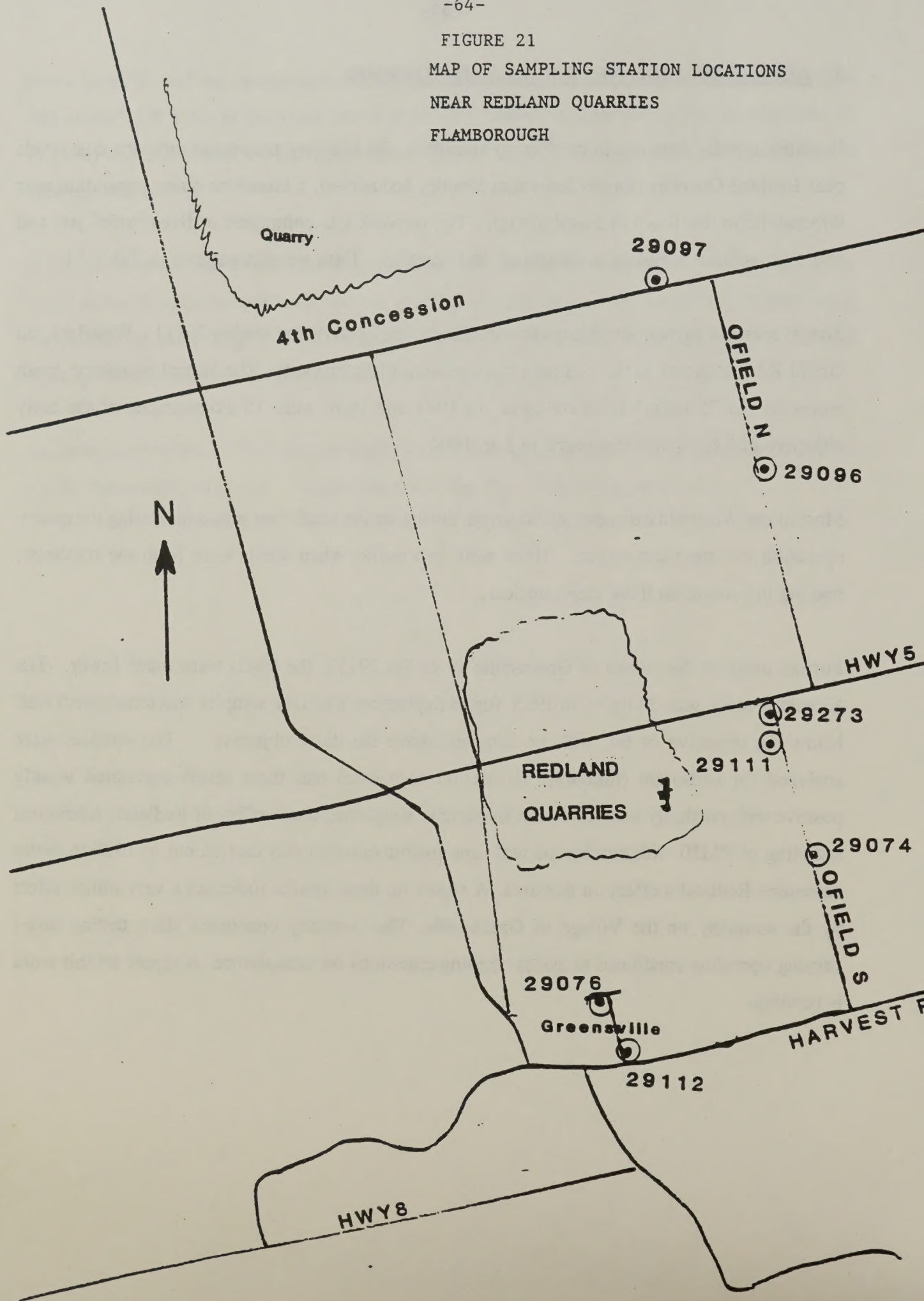


TABLE 14 SUSPENDED PARTICULATES NEAR REDLAND QUARRIES

Ontario Objectives: 120 ug/m³ (24 hr)
60 ug/m³ (1 yr geo.mean)

micrograms per cubic metre

STATION NUMBER	LOCATION	GEOMETRIC MEAN			MAX 1995	% SAMPLES > 120 (1995)
		1993	1994	1995		
29111	Ofield/Hwy 5	80	65	75	476	30
29112	Greensville	29	33	34*	65	0

* Sampler terminated in September 1995

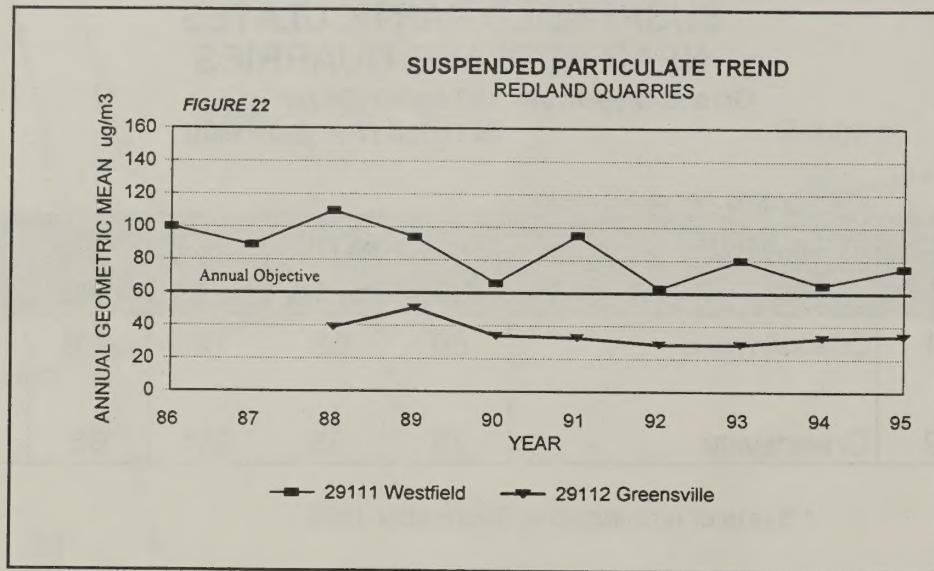
DUSTFALL NEAR REDLAND QUARRIES

Ontario Objectives: 7.0 g/m²/30 days (1 month)
4.5 g/m²/30 days (1 year average)

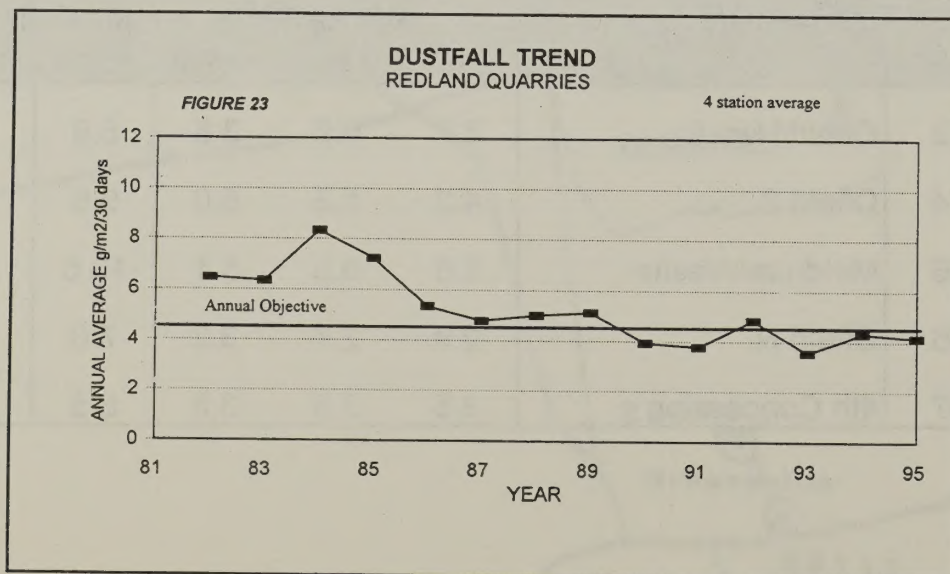
grams / square metre/ 30 days

STATION NUMBER	LOCATION	AVERAGE			MAX 1995	No. of Months > 7.0 (1995)
		1993	1994	1995		
29273	Ofield/Hwy 5	3.7	6.3	3.8	5.9	0
29074	Ofield S.	4.2	5.3	5.0	9.6	1
29076	Meldrum/Wesite	3.6	5.5	5.1	13.6	3
29096	Ofield N.	2.9	2.7	3.2	7.0	0
29097	4th Concession	3.5	3.8	3.3	8.5	1

Trends in suspended particulates at the two stations are presented in Figure 22. While fluctuations are apparent, the overall trend is downward.



Dustfall levels (also Table 14) have similarly improved in the long term as shown by the trend graph in Figure 23.



Concentrations have been fairly steady since 1990. Two stations surrounding the Redland processing plant exceeded the annual objective and these stations recorded 0 - 3 exceedences

of the monthly objective. There was one exceedance at 29097, the station closest to where the active quarrying is carried out, north of the 4th Concession.

Since the late 1980's Redland has instituted many dust controls, including new electrostatic precipitators at the processing plant and numerous fugitive dust control measures at the quarry and plant area. The results of the stack testing will determine if further abatement of emissions is required.

6. DISCUSSION

There are three main air pollution problems in Hamilton. The first is the industrial impact on the nearby residential area, which includes occasional odours, organic pollutants and dust fallout. The second is short-term pollution build-ups throughout the city from vehicle traffic and industry during the spring and fall due to the presence of temperature inversions. The third problem is high ozone levels in summer, due to long range transport of pollutants. Ozone levels again exceeded objectives in 1995. As a long range pollution transport problem, it is being dealt with on a provincial, national and international basis. Nitrogen oxides/volatile organic contaminant control strategies are being implemented in both Canada and the United States and in Ministry generated programs in Ontario. The year 2015 has been targeted to eliminate the ozone/fine particulate smog problem.

Suspended particulate levels have increased by 28% on average since 1993. The Air Pollution Index (API) reached the advisory level of 32 on three occasions during inversion conditions in 1995, all at the downtown station. The city's unique topography makes it very susceptible to inversions, during which times pollution build-ups are unavoidable, meaning such incidents will recur in the future. The frequency of these incidents is in decline however.

Dustfall levels throughout the city have declined since 1987. The 1995 levels were 30% less than those measured in 1986. Efforts by industry to control point sources and fugitive sources by such techniques as the use of chemical sealants, road paving, road washing and landscaping, together with improved street cleaning practices by the City help to explain this trend. Further efforts must be made wherever possible. These can be both industrial and non-industrial in nature, such as controlling blow-off from unpaved areas, excavation, construction, demolition, road traffic and stock piles and related materials handling. Further controls on industrial point sources will also continue where necessary as well as improved operation and maintenance of existing pollution control equipment.

Despite the measured improvement, dustfall in the industrial zone continued to be a problem. Complaints of black fallout in that area, particularly during spring and fall inversion conditions

prompted more intense air monitoring in the industrial zone in an attempt to pinpoint sources better. As well, direct involvement of the Minister led to additional resources for industry specific air emission assessments. These assessments combined with air monitoring data resulted in a two year multi-million dollar abatement plan at Columbian Chemicals. Additional and refocussed air monitoring and movement of the afore-mentioned Technical Team to other industrial sites will result in sustainable long term air quality improvements.

New measurements of organic chemicals indicated that volatiles such as xylenes and toluene were well within guidelines throughout the city. Other important volatiles including benzene, do not have guidelines, so the significance of these readings is unknown. Vehicle traffic appeared to be the dominant source for most of the contaminants except benzene and naphthalene. The industrial zone appeared to be the prime source of these contaminants. Other semi-volatile organics known as polycyclic aromatic hydrocarbons (PAH) were also clearly industrially related and exceeded the guideline for one contaminant. Levels were highest in the industrial zone and at the Beach Strip. Control programs at the major steel mills are already underway to reduce these organic vapour emissions. Some success may have already been achieved as PAH were reduced by 35-60% in 1995.

Much of the air monitoring conducted in Hamilton is automated and linked via a Province-wide telemetry system. This system permits all of the Ministry's stations with continuous analyzers to send data directly to a central computer facility in Toronto allowing for data retrieval on a real-time basis. The system allows for immediate access to pollutant and wind/temperature data both in the Regional Office in Hamilton and in Toronto, and also allows for remote control and maintenance of the instruments. This results in a more efficient monitoring program.

One purpose of the telemetry system is to facilitate the Air Quality Index (AQI). The AQI is a function of six different pollutants which form up to eight separate subindices. The highest hourly subindex becomes the AQI. Concentrations of sulphur dioxide, soiling index, carbon monoxide, nitrogen dioxide, total reduced sulphur and ozone are all individually converted to the old scale of index numbers (although not all AQI stations measure all six pollutants and eight subindices). The advisory or alert levels remain the same as previously 32, 50, 75, and 100.

The old Air Pollution Index (API) has been retained as one subindex and will continue to be used for industrial action requests should the API reach or exceed 32.

In Hamilton, four separate AQIs were reported for the east, west, mountain and downtown stations during 1995, but the East station was closed in 1996 due to Ministry cutbacks.

Due to ongoing concern about the impacts of air pollution and recent data showing health effects at lower levels than previously thought, the Hamilton Air Quality Initiative has been implemented. This initiative brings together different sectors of the community and all levels of government to evaluate existing data, identify sources of air pollution and their impacts and make practical recommendations for improvement. A report is expected in 1997.

7. References

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